HANDBOUND
AT THE
UNIVERSITY OF
TORONTO PRESS

Digitized by the Internet Archive
in 2010 with funding from
University of Toronto

http://www.archive.org/details/electricalnewsen13donm

CANADIAN

ELECTRICAL NEWS

—AND—

Engineering Journal

VOL. XIII.

106874
21. 12. 10

1903:
The C. H. Mortimer Publishing Company of Toronto, Limited.
Toronto, Canada.

E44
13

INDEX

A

Aluminum 6
Amalgamated Engineers, Dominion Institution of 16
Andrewsville, Electric Plant at 25
Aluminum as a Conductor 52
Alternator Frames 54
Alternators, Compounding 98
Announcement No. 6-xviii
American Street Railway Association 207
Aids and Appliances, First 226
Acetylene Gas Explosions 243

B

British Columbia Electric Railway 23
Brakes, Momentum Railway 24
Bell Telephone Company 41
Brakes, Street Car 70
Bell Telephone Company in Toronto 108
Bearings Anti-Friction 113
Badger, The Late F H 165
Bearings. Value of Oil Rings in 173
Belting for Electric Work 180
British Practice 224
Boiler, Steam, Inspection in British Columbia 229
Burners. Electric and Gas, New No. 11-viii
Boiler Inspection 158
Belt Tightener, Automatic 246
British vs. American Methods 240
Boiler Explosion, The Newmarket 238

C

Compressed Air, Comparison of with Steam and Electricity at Rossland, B.C. 14
Converter. A New 22
Canadian General Electric Company 36
Canadian Electrical Association 37, 86, 122, 123, 238
Central Stations, Cleanliness in 55
Canadian Electrical Association Convention 55 73
Currents, Two on One Wire 67
Cascade Water Power and Light Company 68
Canadian General Electric Company, Offices of 87
Crane, Electric Travelling 101
City Hall The Electric Plant at 104
C P R. Telegraphs 108
Ceco Electrical Machinery 111
Canadian Electric Light Company 121
Cables, Submarine Electric Power, Some Points Relating to 152
C.E.A. Convention, Notes of 160
Canadian Industries, New 170
Conduits, at Niagara, Power Cable 175
Cataract Power Company. New Equipment for 175
Chimneys 178
Current, Converting Alternating into Direct 187
Canadian Field, The, Entering 189
Canadian Niagara Power Company, Bridge for 193
Canadian Emigration Offices, New 210
C A S E Secretary, The 212
Calamity, An Appalling No. 11-x
Calgary, Electric Power Development for 238

D

Dick, Kerr & Company, Manufacturing Plant of 1
Direct Connected Units, Standards for 23
Dominion Iron and Steel Company, The, Power Station of 65
Dynamo Tender, The, Hints for 74
Distilled Water, Using No. 6 iv
Dominion Exhibition 173
Dwight, Mr. H. P., Resignation of 213

E

Electrical Engineer, Demise of 10
Electric Company, A Progressive 16
Electrical Apparatus, Imports of 16
Electrical Development in the West 20
Electrical Device for Factories 39
Electric Companies, Amalgamation of 54
Electricity, The Possibilities of 54
Eaton Departmental Store, Electrical Equipment of 100
Electrical Engineers, American Institute of 159
Electrical Workers, Brotherhood of 162
Electric Companies, Interesting Suit affecting 192
Emery Wheels, The Bursting of 194
Electrical Development Company of Ontario, Limited 201
Engineers' Banquet 212
Engineering Students Visit Peterborough 225
Engineers' Dinner, Toronto 231
Engineering Project, Vast 233
Electrical Section, Meeting of 242
Electric Light Inspection 243
Electricity, Transmitting. New System for 246

F

Fan Motors 98
Fan Motors, Operating No. 6-xii
Fort William, Municipal Services at 177
Ferns, Mr. James 183
Field Day, First Annual 202
Fuses, Enclosed 204
Frequency, Choice of 20
Field Coil Temperatures [illegible]

G

Gasoline Engine, The Eclipse 4
Governor, The R[illegible] Armstrong-Sweet 61
General Electric Company, The Annual Report of 75
Great North-Western Telegraph Company 107
Gas Engine, Running a 114
Gas Engine, Care of a 115
Gas and Electricity, Combining 199
G.N.W. Telegraph Company, The New Manager of 228
Granby Co., The, New Compressors of, at Phoenix 235

H

Hooper, G.H.B., The Late 10
High Tension Engineer, The Training of 149
Hill Electric Switch Co., The No. 12-ii

I

Indicator Cards 44
Indicator, the, Steam Accounted for by 47
International Transit Company and Trans-St Mary's Traction Company, The 209

J

Jenckes Plant, the, a Visit to 112

K

King Edward Hotel 102
King Edward Dynamo and Motor No 6-xviii
Kamloops, Electric Light and Water Works Plant at 166
Kuhlman, Mr. N V. 232
Kakabeka Falls, Power Development at 239

L

Lineman, The 41
Lachine Rapids Hydraulic and Land Company 44
Lamp, The Enclosed Arc 45
Lamp, The London Standard 55
Liquid Air for Power Purposes 79
Legal Decisions 120
Lights Incandescent, Nernst and Osmium 168
Lightning, Grounded Wire as a Protection against 172
Light Costs 173
Lamp, A New 204
Line Foremen, Rules for 233
Lamp, Incandescent, The, Possibilities of 251

M

Moonlight Schedule 15, No. 2-ii, No. 3-vii, 63, 77, 82, 106 No. 6 ii, No. 9-ii, 216, No. 11-ii.
Montreal Correspondence 16, 31, 36, 62, 115. No. 7-xiv, 176, 211, 232, 247.
Mexico Power Project in 29
Midland Electric Light Arbitration 29, No. 3-iv
Montreal, Electric Companies in, Amalgamation of 59
Motors, Induction, Speed Regulation of 51
Motors for the Lachine Canal 62
Metropolitan Electric Railway 96
Motor Vehicles, Speed of 115
Motors, Variable Speed, and Their Relation to New Shop Methods 151
Motors, Single Phase, as a Means of Increasing Station Earnings 153
Montreal Light Heat & Power Company 159
Motors, Induction, Variable Speed 171
Motor, Induction, Bullock 173
Metric and the English System, The 191
Memramcook, Electric Plant at 197
Motor A Tide 198
Main Drive, A 100 H.P. 212
Montreal Light, Heat & Power Company, The New Transforming and Distributing Station of 217
Meters Packard Type G, Abroad 12-x

N

Niagara Development 6
Niagara Power Development, Canadian 17
Nernst Lamp 23
Niagara and Its Power 176
Nova Scotian Electric Plant 202
Nernst Lamp, The, Treatise on 202
Niagara Falls Power 241

O

Ohio Electric Railway, Western 8
Ottawa Electric Railway Company 30
Ottawa and Hull Power & Manufacturing Company. The Installation of 33
Ottawa Electric Company 121
Oil, The Saving of No. 7-x
Oil as a Scale Remover 165
Ottawa Electric Company, Power Plant of 181
Oille, Late Dr. L. S. No. 9-x
Oil Engine Central Station 203

P

Personal No. 1-iv, No 2-ii, No. 3-iv, No. 4,-xii, No. 5 iv, No 6-ii, No 7-ii. 168, No. 9-x, 215, No. 10-xiv, No. 11-ix. 247.
Publications, No. 2-xi, 64, 80, No. 6-iv, No. 9-iv, No. 11-vii, 252.
Power Transmission and Distribution in Utah 53
Pittsburg Electric Club of 61
Priority of Claim from India 197
Preston and Berlin Electric Railway 198
Power Lost by Fly Wheels 198
Pulleys, Wood Split, 5,000 in One Order No. 9-viii
Peck, Mr. John 231

Q

Questions and Answers 11, 21, 43, 60, 78, 110, 169, 190, 208, 223, 244.
Quebec, Electric Project for 79

R

Railways, Suburban Electric 31
Railways, Electric Safety Device for 37
Rapid Transit Tunnel, Electrical Equipment of 71
Railroading, High Speed 224
Railway Composite Telegraph and Telephone System 248

S

Steam Turbine. The 7
Shawinigan Transmission Line 9
Short Circuits 13, 177, 250
Salesman of the Future, The 22
Shawinigan Transmission Plant 29
Stationary Engineers, Hamilton Association 48, 80
Shawinigan Water & Power Company, Transmission Line and Terminal Station of 49
Storage Batteries 55
Street Car Stops 7
Students, Successful Electrical and Engineering 7
Steel Tool, Taylor-White Process of Treating 76
Smith, Late S. Morgan 77
School of Science Examinations 80
Superheated Steam, Cost of 95
Switchboard, Board of Trade 109
Supply House, Great New England 114
Stationary Engineers, Ontario Association No. 6-xvi
Scientist, Honoring a Departed 168
Signs, Electric 170
Steam vs. Electricity 179
Snow, Removing in Montreal No. 9 iv
Switchboards 186
Steam Turbine Plant, Municipal 194
Stationary Engineers, Annual Convention of 196
Switch, New Automatic 202
Steam Turbine, Curtis 206
Sherbrooke, Que., Motor Power Development at 211
South Africa, Importation of Machinery into 214
Smoke Consumers 233
Steam Power Per Annum, Cost of 234
Street Railway Plant, Improvements to 242

T

Telegraphy, Wireless, by the Collins System 12
Transmission Line, A Novel 22
Toronto-Niagara Power Company 29
Toronto Railway Company 30
Transmission A New 38
Telegraphy, Wireless 39
Telegraphy, Wireless, De Forest System of 40
Telegraph Telephone, Electric Light and Power System Combined 42
Transformer Test of a 63
Telegraphy and Telephony, Wireless 72
Toronto Technical School 76
Toronto Electric Light Company 88
Toronto Street Railway 93
Transpositions 98
Transformer Types 98
Toronto Electric Plant in 106
Telephone Competition 114, 177
Transformers, Westinghouse, Winding of 119
Telephone Judgment No 6-iv
Transformers, High Tension 153
Transmission Losses No 8-iv
Train Control 171
Tube Service, The Boston Pneumatic 174
Telegraphy Wireless, Congress of 177
Toronto, Electric Power for 184
Transformers, Multiphase 156
Toronto Exhibition, Exhibits in Machinery Hall at 18
Telegraphic Service for Prince Edward Island 213
Telegraphy Wireless, The Status of 213
Telephone Notes 213
Transmission Apparatus, Display of 214
Turbine The Steam 221
Telephone Service, Glasgow Municipal 228
Thornbury Gasoline Engine & Foundry Co., Limited, The 12-
Telegraphy, Wireless 240
Trolley Catchers 240
Traction, Single-Phase 241
Toronto Electrical Engineers 243
Tests, Some Interesting 243
Traction, Electric, Important Steps in 245
Telephone Equipment, Depreciation of 249

U

University of New Brunswick and its Engineering Department 56
University Conversazione, The, Some Electrical Features of 59
Underground Haulage, Electricity for 66
Union Station, The, Electrical Plant at 103

V

Vancouver Transmission Plant 165

W

Water Pipes, Thawing of, by Electricity 20
Water Power, An Analysis of the Commercial Value of 26
Winnipeg General Power Company 29
Wires, Secondary, Grounding of 39
Water Power in France 46
Water Wheel Governors, Electrically Controlled 58
Wiring, High Tension 70
Westinghouse Company in Canada 81
Wiring Methods and Material 187
Wiring, Conduit 204
Westinghouse Officers, New 207
Westinghouse Company, The Canadian 223
Welland Canal, The, Electric Lighting of 246

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIII. JANUARY, 1903 No. 1.

MANUFACTURING PLANT OF DICK, KERR & COMPANY.

About three years ago the English Electric Manufacturing Company commenced the erection of large works at Preston, England, for the manufacture of electric machinery, Messrs. Dick, Kerr & Company, of London, being large stock holders and acting as selling agents for their apparatus. The latter company recently absorbed the English Electric Manufacturing Company, and now conduct both the manufacturing and sales departments under the name of Dick, Kerr & Company.

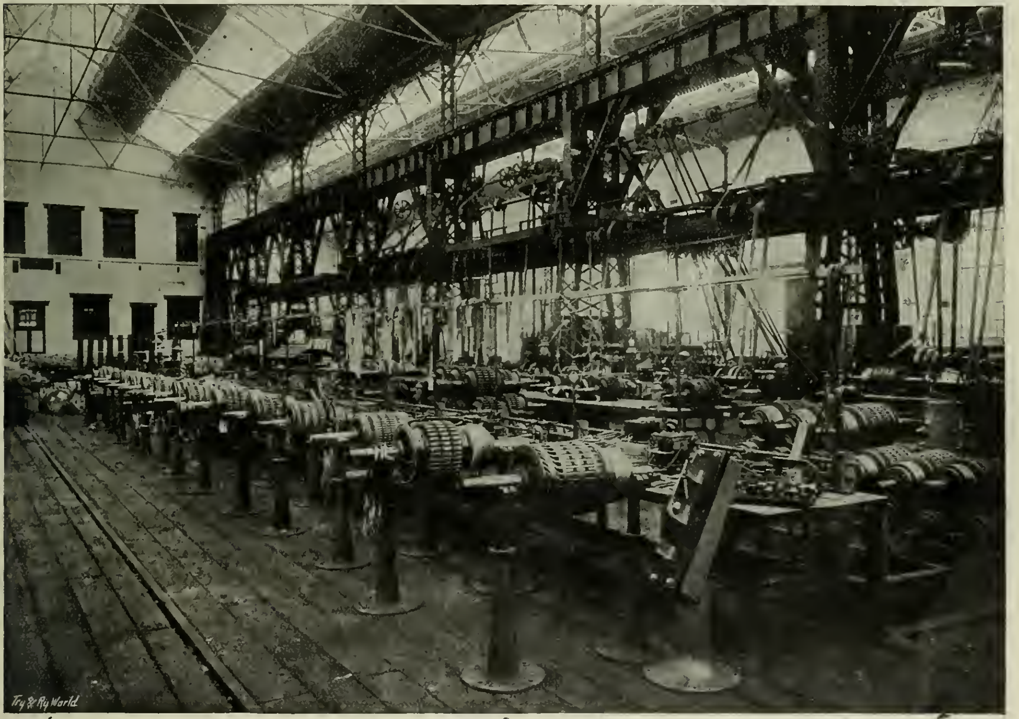


FIG. 1.—ARMATURE WINDING DEPARTMENT.

This company set out with a determination to meet the American competition, which meant a bold departure from English methods. The works that have been constructed at Preston are quite remarkable, the equipment and machinery being in complete accord with modern ideas as to the constitution of a factory and embracing all labor and time-saving appliances which experience suggests. This is evidenced by the following particulars and illustrations of the plant :

BUILDINGS.

Of the twelve acres of land embraced in the company's manufacturing site, about five acres are under roof. The buildings are one storey high throughout except the offices ; they are laid out on the lines of the most recent American engineering works, a steel frame being first erected to carry the cranes and roof structure, and the sides and ends independently walled in. The principal buildings are three in number—the machine shop with the offices, the foundry with pattern and pattern storage shops, and the power-house.

MACHINE SHOPS.

The largest and most important of the buildings is, of course, the machine shop, which is in itself a structure of imposing dimensions 900 feet in length by 120 feet wide, 35 feet high in the clear, and with 25 feet head room under the cranes. Throughout the centre of this building, from end to end, passes a line of double lattice-work stanchions which perform the triple functon of supporting the roof, the crane girders, and the line shafting.

In the general arrangement of the works, and especially in the detailed plans of the machine shop, it has been the chief object to avoid wherever possible the handling and re-handling of the various parts of the apparatus during the processes of manufacture. Raw materials delivered at one end of the main building pass through the successive operations, always moving in one direction, and emerge at the other end as finished and tested apparatus, ready for loading upon the railway trucks waiting to receive it for transportation to any part of the country. Exceptional attention has been paid to the matter of facilitating the progress of the material through the shops by means of powerful high-speed electric cranes supplemented by pneumatic hoists and tracks in every building.

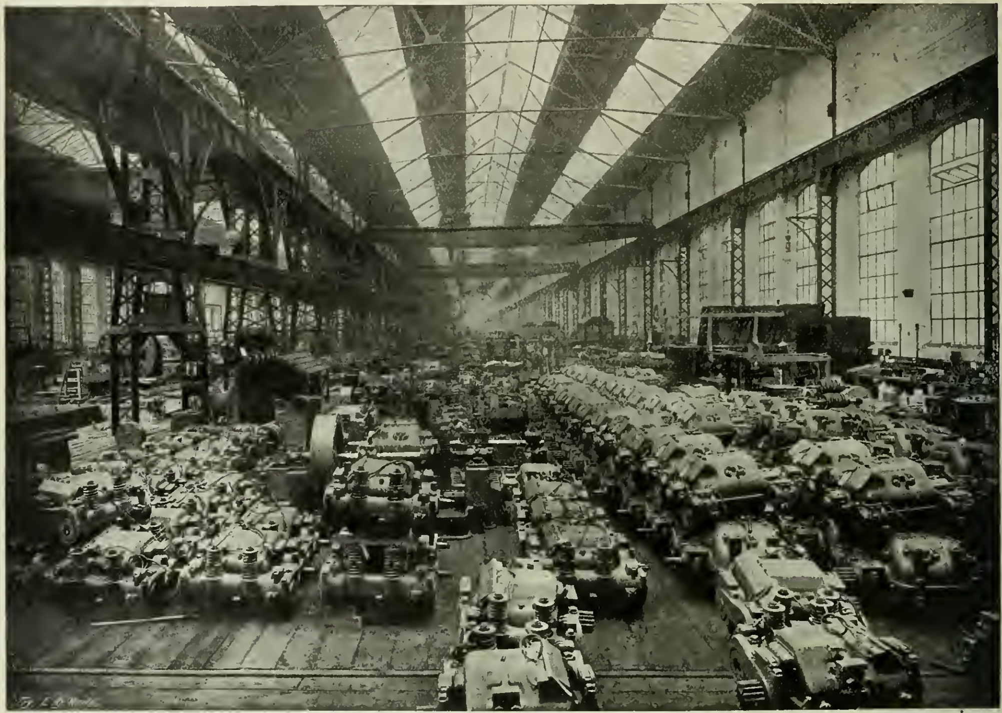


Fig. 2.—Tramway Motor Department.

By means of jib cranes and pneumatic hoists the men operting machines are able to lift into their tools pieces weighing from one to two tons each. Down each bay of the shop is laid a push car track, with an additional track in the centre of the shop running between the stanchions which support the countershafts, cranes, and roofs. It will thus be seen that, in addition to the four large cranes provided in the machine shop, there are three tracks running its full length, thus giving seven ways of handling material up and down the shop.

To facilitate communication between the various parts of the works a telephone system is provided, extending from the offices to all departments. Compressed air at 100 lbs. pressure is distributed to every part of the works, and used in the operation of pneumatic drills, hammers, etc., as well as for operating the pneumatic hoists.

The whole machinery throughout the works is, of course, operated by electric power from the generating station. The limits to which the principle of sub-division of power into small units could be advantageously extended has been most carefully considered. The resulting arrangement in so far as the machine shop is concerned represents entirely new practice, and is worthy of being described in some detail. As has been stated, a sectional line shaft extending the full length of the machine shop is supported from the line of centre stanchions between the two main bays of the shop. The sections of this shaft are driven by individual 50-h. p. motors, direct connected to them by means of a quill shaft and clutch.

The 800 feet of shaft is divided into eight of these sections with their motors; any section of the shafting can be driven by its own motor, or the whole can be driven by any one or more motors. All of the machine tools used in both bays of the shop are thus driven from the one line shaft, except in the case of larger tools, where individual motors are provided. It will be seen that by this arrangement the greatest possible efficiency is secured in the drive of the machinery, since the grouping of the tools of both bays together allows the use of comparatively large and therefore efficient motors, and the frictional losses are cut down to a minimum.

The machine shop is divided into two enormous bays, one on either side of the centre stanchion. One of these bays is devoted entirely to the manufacture of traction motors and details of equipment, while the other is used for the production of heavier machines, such as large dynamos, alternators, rotary transformers, etc. In order to obtain a clear idea of the machine-tool equipment of the shops, and of the operations which are carried on, the simplest method will probably be to make an imaginary journey through the shops.

At the north end of the shop are the receiving and store rooms, into which the receiving track passes. These rooms are fitted with divisions and bins for the reception of the various materials to be used in the manufacture of apparatus. The electric cranes in the two bays unload the materials from the railway trucks and distribute them to the various parts of the store room. From this store room the materials are distributed to the various departments of the works as required.

The first group of tools after leaving the store room constitute the punch and die departments, in which the steel discs required for building up armatures, field magnet cores, etc., are punched with dies into the required shape. Immediately convenient to the punch and die departments is a completely equipped smith shop with power driven hammers, etc., for shaping the steel from which the dies are made. The delicate process of tempering the dies after completion is also carried on at these forges. The die department is fitted with a full equipment of standard lathes, shapers and drill pressers. Worth notice, too, are the grinding machines for grinding the dies with flat cutting surfaces, which slowly move the piece of work backwards and forwards while the large grinding cylinders roll rapidly, and at the same time move along their axes at right angles to the movement of the work, thus ensuring perfectly flat surfaces. Next comes the annealing process, where the armature discs are packed into iron cases and covered with sand to exclude the air. They are then placed in ovens, where they are raised to a dull red heat and then slowly cooled; afterwards being passed through the painting machines, which cover them with the thinnest possible layer of varnish. Issuing from the varnish rools they are dropped on to a moving chain belt, which passes them through a drying oven and delivers them in the assembling department to be built up into cores ready for winding.

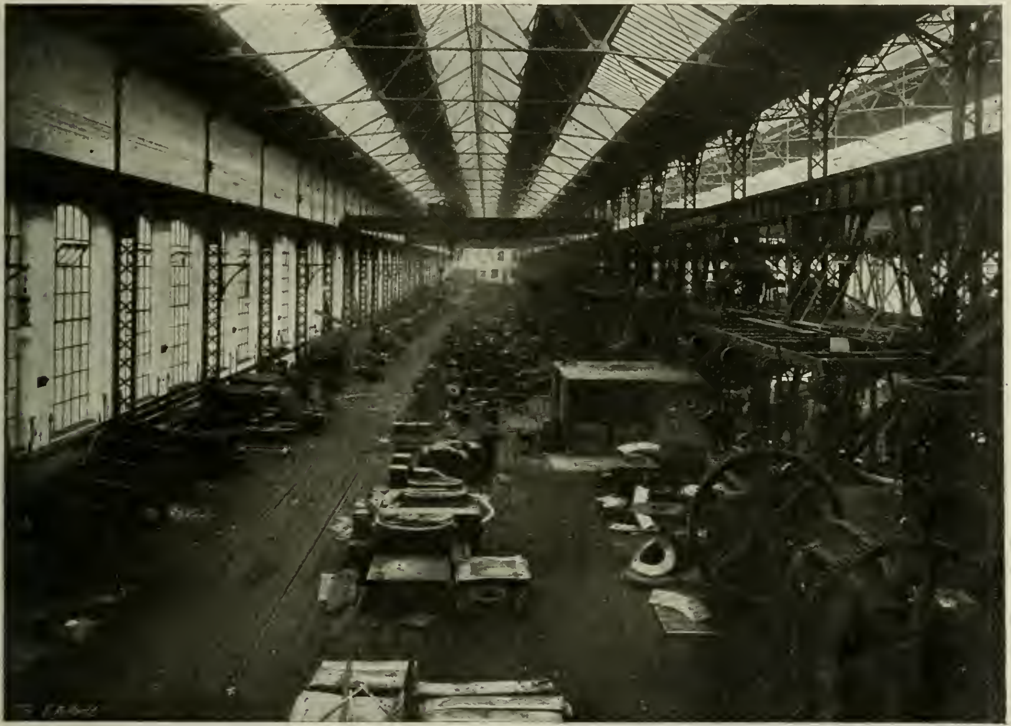


Fig. 3.—General View of Motor Bay.

Moving down the shop, we now come to a second railway track entering the machine shop from the foundry. By means of this track the castings of motor and generator frames are delivered directly to the respective departments equipped for their completion. The first process with the motor castings is to place them on the vertical milling machines, which face the two halves to form a perfect magnetic joint. Next in line are the radial drilling machines, which drill all the holes in the motor frames. After being bolted together, the frames are placed on the horizontal boring mills, which finish the bearings for the armature and axle and bore out the frames to receive the pole-pieces. The frames are now completed and ready for delivery to the motor assembling section. Coming next to this group of magnificent boring mills are the motor shaft lathes and special machines for grinding the armature shaft bearings. Then come the massive turret lathes for finishing the armature and plates, the commutator heads, and the bearing shells. The next group of tools comprising lathes, planers, shapers, milling machines, and many special tools, constitute the brass-working department, where the controllers, rheostats, trolleys, commutators, and brush-holders are made.

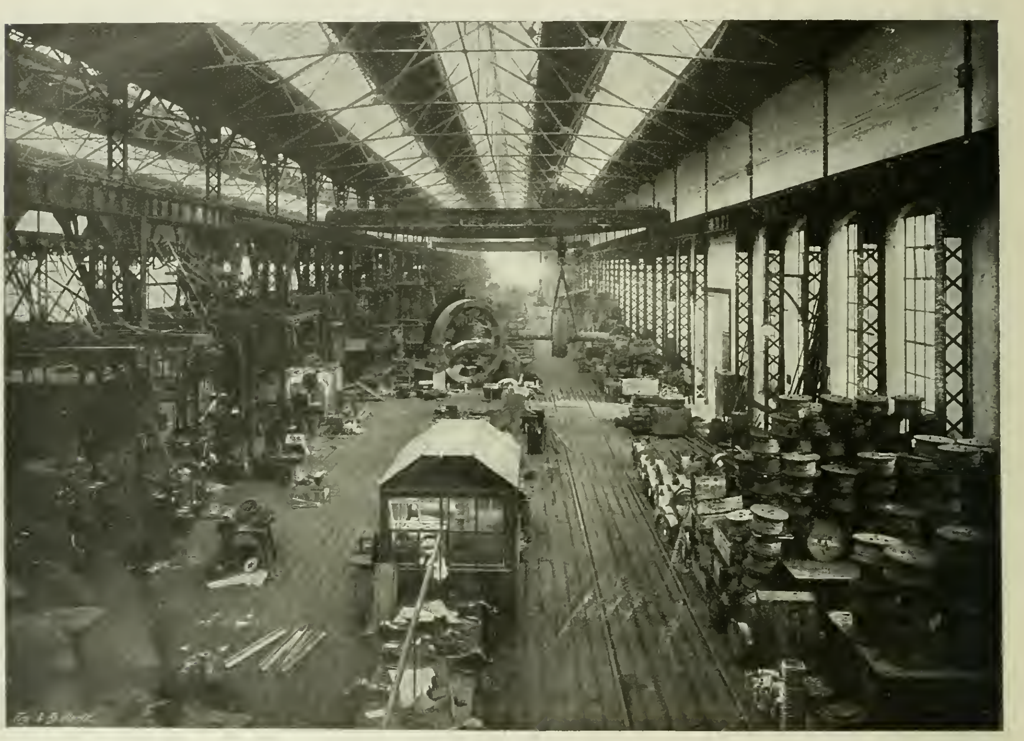


Fig. 4.—General View of Generator Bay.

The next department is the field-magnet winding section, where the motor and generator held-magnets are wound, insulated and baked, and the armature coils placed on the motor armature cores. The motors and controllers have now reached the assembling and painting department, from which they are delivered to the testing department, where they are subjected to severe tests for insulation, etc., and run under full and over load conditions for the specified time. After the tests are completed the temperature of each part is taken, and a thorough examination made as to the quality of workmanship, etc. If perfect in every respect, the completed machine is taken charge of by the shipping department, where it is loaded into trucks on the shipping track, which enters the building at the opposite end from the receiving track.

ARMATURE WINDING AND MICA DEPARTMENT.

The armature winding, insulating, and mica department for motors, dynamos, and alternators is separated from the main portion of the machine shop occupying the extreme south end of the generator bay. A brief description of the operations which take place in this department will be of interest. The armature coils, which are wound or formed entirely by machinery, must be thoroughly insulated with mica, paper, and cotton braiding. They must be properly dried, dipped into special varnish, and then baked, in order to exclude all moisture. Afterwards they are pressed into exact shape and formed to size, so that all coils and windings may be alike and interchangeable. The mica rings and tubes for commutators are moulded under great pressure while being heated. The presses in which this work is being done have their various parts heated by steam pipes passing from the boiler-house to this portion of the machine shop. Nearly all the winding, insulating, and mica moulding in the department is done by girls, and its separation from the main portion of the shop obviates the possibility of metallic chips or filings getting into the insulation.

Returning again to the point where the foundry track enters the machine shop, and coming down the generator side of the shops, we find the largest and finest tools in the plant for machining and finishing the huge generator frames, armature heads, etc. The generator frames after coming from the foundry are first placed on an enormous planing machine, to be faced at the joints. The bed of this planing machine is 24 feet long, and will receive a casting of this length ;

this tool is driven by its own motor, and weighs 75 tons.

The next tool is the largest in the works, being a boring mill swinging 24 feet, for boring out armature heads to receive the engine shafts, to finish the armature end rings for large generators, and to make the large commutators for these machines. This mill weighs over 100 tons. Next comes a universal boring and milling machine which, while not so heavy as the boring mill last mentioned, occupies more room, its table, flush with the floor, being 24 feet square. Along one side of this table travels an upright pillar about 10 feet high. To this pillar is attached a spindle, which can be moved to any position, vertical or horizontal, within the limits of the tool. Generator frame castings are placed upon the table of this machine, the holes are bored, surface milled—in fact, all the remaining machine work being finished without moving the casting. For the armature heads of large dynamos and alternators, portable slotting machines are provided, each with its own motor, which cut the keyways for the engine shafts and the dovetailed slots for fastening the armature laminations. The machine work on the generator frames is now finished, and they next proceed to the assembling department opposite the shipping track, where they are erected for test, each generator being thoroughly tested for insulation, output, temperature and commutation. In the testing room there is arranged a complete switchboard about 48 feet long, with a full assortment of approved testing instruments of wide range. Through the switchboard is also arranged a supply of alternating current at various pressures for testing insulation, and from it as well is distributed all the power for the different parts of the works. In the testing department there is provided live steam from the boiler house, so that complete engine dynamo sets can be tested with perfect ease, and without the necessity of making special arrangements.

FOUNDRY.

The foundry building is parallel with the machine shop, with a space of 60 feet between the two. It is 465 feet in length and 120 feet wide. It is equipped with two 30-ton and two 15-ton electric cranes. In this building are contained the iron foundry department, the brass foundry department, the pattern shops, and the pattern storage shops. Two cupolas are provided for moulding iron, and five brass furnaces for making the brass parts for motors, generators and switchboards. The iron foundry is used for making the frames of the very large generators and alternators for the manufacture of which these works are specially equipped. In both the brass and iron foundries the machine tools provided are driven by an independent motor.

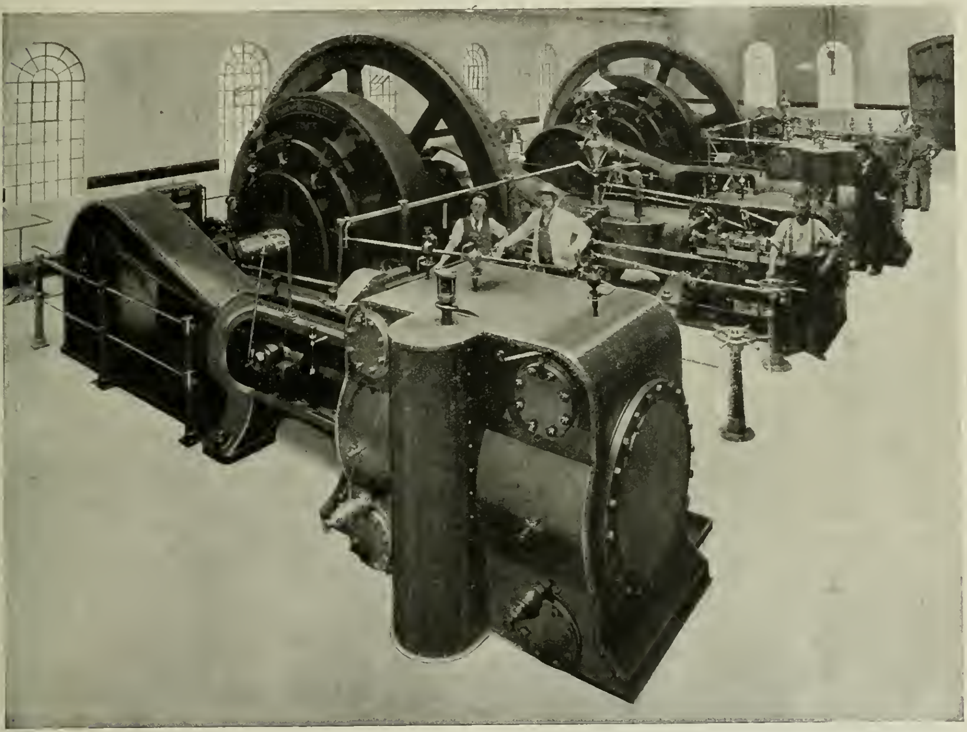


Fig. 5.—Interior of Power House.

POWER HOUSE.

To provide the necessary power for the shop operations as well as the lighting calls for considerable plant; for this purpose there are two cross-compound Corliss engines, each direct connected to a generator of 400 horse-power capacity. There is, therefore, available at the present time 800 horse power, with a possible overload capacity of 25 per cent. The battery room contains a 500-volt Chloride accumulator set, which is used for supplying light and power throughout the works at night when the power plant is shut down. The reservoir, with a capacity of 60,000 gallons of water, receives its supply from an elaborate system of roof drains. A cooling tower, erected over one portion of the reservoir, cools the water coming from the condensers of the engines.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.

BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2290.

22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.

1ST VICE-PRESIDENT:
EDWARD SLADE, General Superintendent Jacques Cartier Light & Power Co., Quebec.

2ND VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
ORMOND HIGMAN, Chief of Electrical Inspection Department, Ottawa.
ED. A. EVANS, Manager Quebec Railway, Light & Power Co., Quebec, Que
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
A. SANGSTER, Manager Electric Light & Power Co., Sherbrooke, Que.
A. A. WRIGHT, M. P., President Electric Light & Power Co., Renfrew, Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON,	Toronto.
Vice-President, CHAS. MOSELEY,	Toronto.
Treasurer, A. M. WICKENS,	Toronto.
Registrar, J. G. BAIN,	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN,	Hamilton.

TORONTO A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER	Baden, Ont.
Vice-President, H. E. TERRY	Toronto, Ont.
Secretary, W INGLIS,	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont.
Conductor, J. STRUTHERS,	Sarnia, Ont.
Door Keeper N. BEAN,	Waterloo, Ont.

NEW YEAR GREETINGS.

The ELECTRICAL NEWS wishes all its subscribers, advertisers and friends a Prosperous New Year.

Niagara Development. It is interesting to note that the contemplated developments on the Canadian side of the Niagara river will, if carried out in their entirety, result in a total capacity far exceeding those across the line, and further in the light of the experience gained in the operation of the Niagara plant, those now building will possess many new and valuable features not found in the original equipment. The The Canadian Niagara Power Company and the Ontario Power Company are now both at work on their hydraulic development, while a third organization, composed mainly of Toronto gentlemen, is making application for a location and water rights. The installation of these plants will mean the expenditure of many thousands of dollars in all branches of business throughout the country, besides which there will be the equipping of the numerous industries which will doubtless adopt electric illumination and power as soon as the attractive rates of the water driven station are offered to them.

Aluminum. The use of aluminum in the electrical industry has not become common practice to any great extent, though a short time ago the outlook indicated that it would rapidly force its way to the front, and to a material extent replace copper bus bars and line wires. Its general characteristics as compared with copper, of which, outside of the telephone and telegraph fields, it is practically the only competitor, are well known. Weighing about one-third that of copper, with a specific resistance some 40 per cent. greater, and having a tensile strength about 40 per cent. less, it is made commercially pure for such shapes as bus bars, where strength is of no consideration and maximum conductivity is all important; for small wires an alloy of 1 to 2 per cent. is introduced to increase the tensile strength, though slightly greater resistance is the natural result. From the above it follows that an aluminum wire of equal conductivity to any given size of copper will be about 60 per cent. greater in diameter, and while weighing slightly less than half as much, will sustain a somewhat greater load. It cannot be soldered without much trouble and it is therefore customary to make joints in transmission lines by McIntyre connectors, in cables by joint clamps. The self-induction is slightly less than in a copper line of equal conductivity, the skin effect is practically the same, the charging current slightly greater. The effects of varying climates are not very well known, as most of the data now available has been obtained from California, where the thermometer does not go very low, though experience there tends to show that its use beside salt water is almost impractical, as it is very easily attacked by the salt which is carried in suspension in the surrounding atmosphere. It would be interesting to learn what service it would give under the low temperatures which obtain at certain seasons of the year in some parts of this country ; trouble might be expected from excessive slackness or tightness of the lines according as the thermometer went up or down, the coefficient of expansion being somewhat greater than that of copper.

The Steam Turbine.

In the struggle to produce goods at the cheapest possible price compatible with a satisfactory product, much attention is naturally given, and has been for years past, to the cost of the power used in manufacturing. This forms a large part of the cost of practically all goods turned out by machinery, and therefore the efforts of all engineers and manufacturers have long been concentrated on attempts to reduce it to the lowest possible point. One of the most obvious means of lessening cost is to increase the rate or size of production, and hence the tendency in steam engineering has been towards constantly increasing engine sizes, until they have reached a point where physical and mechanical conditions call a halt. This being the case, attention is naturally turned elsewhere to find an outlet from the difficulty, and it is to the steam turbine that the eyes of the mechanical world are directed in an effort to get steam power at a cost that is lower than that which now obtains. This new adaptation of an old principle is now rapidly pushing its way to the front as a competitor of the ordinary reciprocating engine, and as its present field is almost entirely that of driving dynamos for power distribution, its development is being watched with great interest by electrical men the world over.

The fundamental difference between the two types of engines is that in the reciprocating form the energy in the steam is used expansively to push a piston along ; in the turbine the power is turned into energy in the shape of velocity. The steam issues from a nozzle at a high speed and then impinging upon the blades of the rotating member turns it round at an extremely fast rate. This at once introduces to the electrical designer a new problem of large, direct-connected dynamos for high speeds, very high speeds, as opposed to the low speeds which have hitherto been required by the present day type. Standard direct-connected units of about 300 k. w. and larger operate at from 100 to 70 revolutions per minute; the steam turbine requires that these figures shall be changed to about 3000 r. p. m., down to 700 or 800. This naturally introduces many new features into the electrical part of the equipment ; on the whole it means smaller and lighter and therefore cheaper dynamos for the same output. Another valuable feature arising from the nature of the apparatus is that there being nothing but rotary motion, as in the water wheel, the difficulties of driving alternators in parallel and the hunting of synchronous apparatus are entirely eliminated, the turning movement or effort is absolutely uniform, and so there is no tendency to generate cross currents between the various machines connected to the circuit. Further than this, due to the high speeds, the fly wheel effect is greater than in ordinary reciprocating units, which means that the new type is able to carry a varying load with closer speed regulation than the other. In the driving of direct current machinery some difficulty is experienced in obtaining satisfactory commutation at the high speeds involved ; perhaps the long abandoned unipolar dynamo may again come into use to surmount this obstacle.

The principal advantages which the turbine offers over the present standard form of steam engine is that even to-day with the comparatively small experience which its builders have had, it has a steam economy practically equal to, if not excelling, the best results which have hitherto been produced by the other type. This is true not only of the larger sizes, but also of the smaller. More noticeable still is the fact that the steam consumption is not very materially increased when running at partial loads. Again, as a natural result of the high speed, the apparatus is smaller and lighter, which means a decreased cost for foundations, power house buildings and the land they stand on. This is especially true of foundations, which can be made materially lighter owing to the absence of all strains or moving tendencies. It has been estimated that they will cost 15 to 30 per cent. of those for the present style of unit, the total power house expenditure outside of the apparatus itself being approximately only 50 per cent. of that required for the reciprocating type. The light weight has a further effect in lessening the total cost,in that shipping and erecting charges are much reduced, as is also the time required for installation, which in large engines as built to-day may occupy many months. Data available at the present minute shows that the use of superheated steam and a high vacuum are prime essentials to the highest steam economy. As there are no rubbing surfaces, such as the piston and cylinder in contact with the steam, the greatest difficulty in the use of superheating, namely, that of obtaining satisfactory lubrication, is not present ; and so we may expect to find this a very prominent feature in future developments. This brings forward another extremely valuable feature, namely, that the condensed steam may be immediately returned to the boilers, without filtration or any other cleansing processes, and still not have any harmful effects upon them, as would be the case did it contain oil, as it does when it comes from an ordinary cylinder. Priming, or the passing over of entrained water from any source, has no dire results such as are so well known to all users of the reciprocating engine ; nothing happens beyond a slackening of the speed until the water has passed through. In those types which use their steam in stages similarly to a compound engine it is usual to provide a bypass whereby high pressure steam may be admitted to the low pressure spaces. This allows the carrying of full load with the condenser shut down ; if it is in operation, 50 to 60 per cent. overload.

Space prevents our giving many interesting examples of the above points, but enough has been said to show the principal differences between the old and the new, and the numerous advantages which the latter appears to offer, not to the large manufacturer only, but also to the smaller industries. That these are being appreciated is evidenced by the many installations, both in course of construction and prospective, which are to have the steam turbine as their prime mover.

A Goldie & McCulloch engine has been installed in the power house of the Canada Carriage Company, Brockville, Ont.

THE WESTERN OHIO ELECTRIC RAILWAY.

The Western Ohio Railway Company operates at the present time 47 miles of road and has under construction 64.5 miles more. The portion of the line now in operation begins at Lima, in Allen County, Ohio, runs south from Lima to Cridersville and Wapakoneta, west to St. Marys, south from St. Marys to New Bremen and Minster and finally west from St. Marys to Celina.

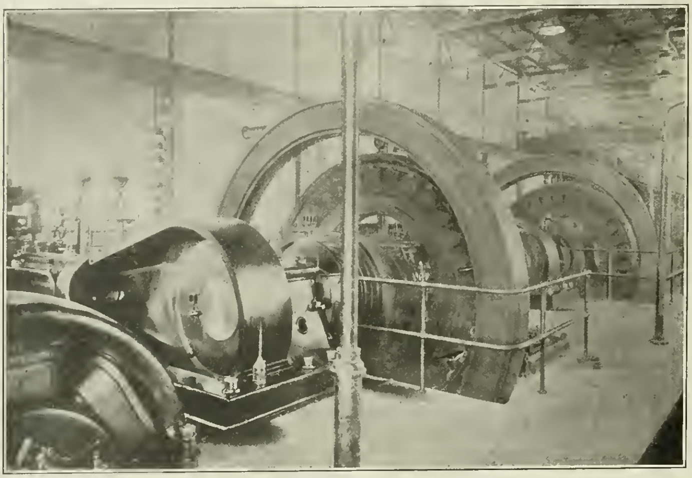


Fig.—Two 400-Kilowatt Three-Phase Alternating-Current Engine-Type Alternators, 400 Volts, 100 Revolutions per Minute.

The main power house is located at St. Marys. The building is of brick and concrete of the following general dimensions: Extreme width, 104 feet; extreme length, 248 feet; width of boiler room, 45 feet; and width of engine room, 52 feet. The roof over the entire building consists of flat steel trusses carrying three-inch tile, with a four ply asphalt and gravel covering. The engine room is supplied with a 25-ton Chisholm & Moore, hand-power travelling crane.

The maximum capacity of this station, according to the present plans, will be 4,000 k.w. The engines are of the C. & G. Cooper, horizontal, cross-compound, condensing type, with Corliss valve gear, and were designed for parallel operation on alternating current three-phase work, with a guaranteed regulation of 1 per cent. The boiler equipment consists of eight Stirling boilers, of a total capacity of 6,000 h.p. These boilers are equipped with flat grates and are all hand fired, coal being supplied directly in front of the fire doors by a Hunt industrial railway system consisting of a narraw gauge track with turnouts, track, scales and steel cars, each having a net capacity of one ton.

The pump and condenser room in this plant is located in the centre of the main boiler room and contains all of the feed pumps, feed-water heaters, circulating pumps, vacuum pumps and condensers for the entire plant. The main steam header consists of 16-in. heavy, lap-welded, steel pipe. Valves over 8-in. in diameter are by-passed. The main steam header is carried on a specially designed, cast-iron roller frame, one end resting on the rear of the upper walls of the boiler setting, and the other being built into the brick-work of the division wall between the boiler and engine rooms. All feed valves are arranged to be controlled from the boiler floor line, as are, also, all drips, gauge-cocks, water gauges, water columns, blow-off pipes and drains around the boilers.

The electrical apparatus was furnished by the Westinghouse Electric & Mfg. Company, of Pittsburg. The main generating units are direct connected to their several engines and each of the two units now in operation is of 400 k. w. capacity. The machines are of the revolving armature type, the armatures having three-phase windings for a normal out-put of 400 k. w. Throughout the armature spider, core and winding, large ventilating ducts have been provided which permit a free circulation of air during operation. For exciting the main generators there will be two units, both steam driven and of the Westinghouse type, the generators, of 100 k.w. capacity and opreating at 125 volts and 200 r.p.m., being direct connected to two 13 x 22 x 13-in. Westinghouse compound engines.

The main power house contains also a sub-station, that is, a portion of the low potential current from the main generators is carried to two 400 k. w. rotary converters supplying approximately 25 miles of the feeder system of the line. The rotary converters in the other substations are all of the Westinghouse type and of 200 k.w. capacity. The armature winding of the rotary converters is similar to that of ordinary direct current generators, but it is tapped at certain points from which leads are carried to collector rings at one end of the staff, while the ordinary direct current commutator is at the other end. The ratio of conversion, A.C. to D.C., is about 0.62. These rotary converters operate at a speed of 500 r.p.m., and deliver 333 amperes at 600 volts. For starting a small induction motor is permanently mounted on the same shaft with the armature.

The engine room at the power house will contain two switchboards, a main generating board containing eleven panels and an alternating current board of nine panels, upon which will be

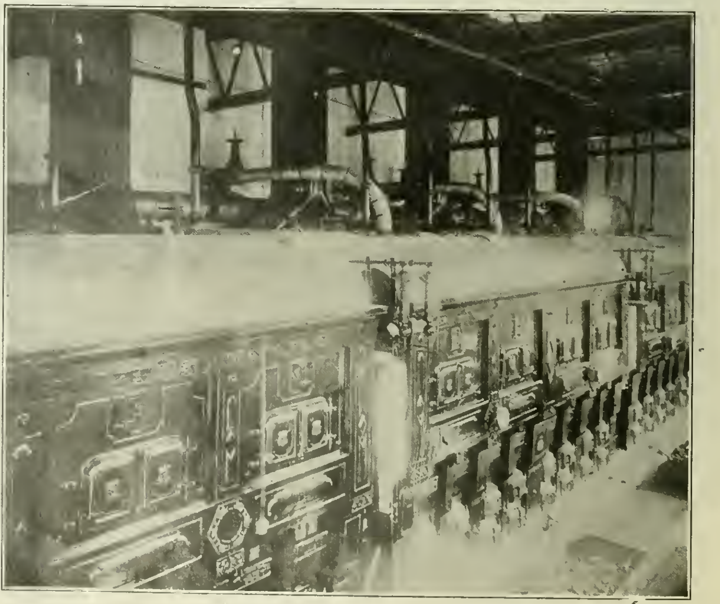


Fig. 2.—Partial View of Boiler Room, Central Power-House, St. Mary's, Ohio.

mounted the high tension switches for all outgoing transmission lines. All instruments on the boards are of the Westinghouse, long scale, dead-beat type.

The step-up stationary transformers, which are located in the basement, are of the Westinghouse oil-cooled type. There will be seven of 400 k.w. capacity, transforming the current from 390 to 33,000 volts. From the transformers lead-covered, single-conductor cables will be led up the south wall of the building to the high-potential circuit-breakers, of which there will be nine of the Westinghouse type mounted on a wooden frame-work.

The sub-stations along the route will be seven in number and will be located as follows: Rawson, Beaver Dam, Lima, Wapakoneta, Anna, Sidney and Lockington. The sub-station buildings will be of brick, with 13-in. walls above the foundation line, the coping being covered with cement. The floors in all sub-stations are to be of concrete, as are also the transformer pits.

In addition to the sub-stations mentioned, there will be a portable sub-station mounted on a car. The equipment includes one 200-k. w. rotary converter; three 150-k. w. step-down transformers; three "low-equivalent" lightning arresters; three fuse switch circuit-breakers with barriers, and one three-panel switchboard.

The high tension line from Wapakoneta to St. Marys is carried on 45-ft. poles, the top of the poles being arranged for three sets of 33,000-volt lines. At Wapakoneta one set turns off south and supplies the sub-stations at Anna, Sidney and Lockington. The other two sets continue north as far as Lima, one set supplying Wapakoneta and Lima and the second set supplying Beaver Dam and Rawson. The transmission cables themselves are all carried on steel pins with wooden tops and porcelain insulators. The cross arms are of long-leaf yellow pine, fastened to the pole with two ½x12-in. carriage bolts. All the high-tension lines are completely spiralled every mile, each set being spiralled on a direction opposite to the adjoining one, thus keeping the same phase feeders on the two pins next to the pole on each side.

The first eight cars on this road were built by the G. C. Kuhlman Company, of Cleveland, and comprise five passenger coaches and three combination passenger and express coaches. The cars are 42 ft. 6 ins. over all and are mounted on Peckham trucks. The electrical equipment consists of four Westinghouse No. 56 railway motors. All cars are double motored and are geared up to a maximum speed of 48 miles per hour. Straight air brakes are used and each car is supplied with an independent motor-driven compressor mounted on a dust-proof box on the under side of the car.

The road bed on the first 47 miles of this property is of standard interurban railway construction, consisting of 60-lb. steel rails 30 ft. in length laid on 5 x 7 x 7-in. ties. The road bed is heavily ballasted throughout with rock crushed to 1½-in. ring gauge and screened, and is from 8 to 12 ins. in thickness under the ties. The entire line is built upon private right of way. The maximum grades on the line now operating will not exceed 2 per cent except at points where the line crosses over the main lines of steam roads.

The poles on this line are all of Michigan cedar, 35 and 45-ft. lengths with 7-in. tops, all thoroughly guyed and braced on all curves. It has been the aim to make the over-head line substantial in order to stand the high speed of heavy railway cars. Above the trolley is strung a 211,000 C.M. feeder, carried on a cross-arm 12 ins. above the trolley bracket. On these same cross-arms over the entire route are carried the telephone lines, there being an iron box telephone in a wooden booth at each turn-out, where all cars must report. This telephone system is carried into the general offices of the company at Lima, where the despatcher is located, so that he is constantly in communication with all of the cars on the system, as well as the power-house and sub-stations.

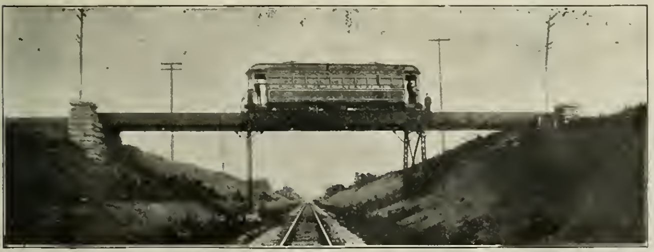


Fig. 3.—Overhead Crossing, Western Ohio Railway, over Track of Chicago & Erie Railroad.

The portion of the road now in operation traverses the Lima-St. Mary's oil fields, which are among the heaviest oil producing districts in the country. It also traverses a rich farming territory and the prospects for freight on this road are very bright. The rate of fare charged is approximately two cents per mile, and the run from Lima to Minster, a distance of 36.8 miles, is being made in 1 hour and 46 minutes including all stops.

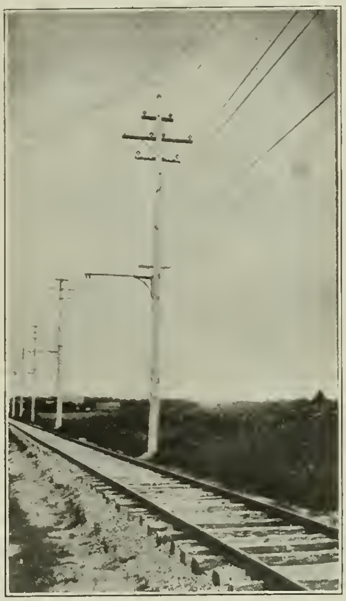


Fig. 4.—Forty-Five-Foot Pole Line Carrying Both Trolley and Transmission Circuits.

THE SHAWINIGAN TRANSMISSION LINE.

The pole line for transmitting electric power from Shawinigan Falls, Que., to Montreal, a distance of eighty-five miles, has been completed. The power will be utilized by the Lachine Rapids Hydraulic & Land Company, who have been making extensive improvements with that end in view. It is proposed to transmit 8,000 electrical horse power. The current will be brought into the city at 50,000 volts. At the distributing station it will be stepped-down to 2,000 volts, at which pressure the 8,000 horse power will be delivered to the Lachine Company. One of the interesting features of this work is the fact that aluminum wire is used for transmission purposes. It is the first output from the factory of the Northern Aluminum Company, the Shawinigan branch of the Pittsburg Reduction Company. It is expected that the Shawinigan plant will, in a few years, be the largest aluminum-producing plant in the world.

Some 4,500 poles have been planted for the support of the three aluminum conductors which are strung upon them. Each conductor consists of six ⅜″ wires twisted together. A special porcelain insulator has been used.

At Bout de l'Ile the river is spanned and the Island of Montreal reached by means of a heavy steel cable, suspended above the water from two steel towers, one on each shore. The span is 1800 feet in length.

DEMISE OF AN ELECTRICAL INVENTOR.

In the death of George Henry Bingham Hooper, which occurred at Grace Hospital, Toronto, on December 9th, 1902, there passed away an inventor and electrician who had devoted a life-time to perfecting the design of apparatus pertaining to the electrical industry. His inventions included a generator, a circuit breaker, an improvement in storage batteries, the Hooper electric marine engine, an automatic cartridge extractor, and an improved lathe device. His greatest accomplishment, however, and that to which he had given most attention and study in recent years, was the Hooper magnetic electric brake, the design of which is shown in the accompaning illustration.

The Late G. H. B. Hooper.

The late Mr. Hooper was a very enthusiastic electrician, and it may be truly said that he never received the financial reward to which his inventive genius was entitled. At the time of his death a company was in process of formation to exploit and manufacture his electric brake, but after spending many years in its development, and just when it seemed he was about to reach the ultimate goal, he fell a victim to the continuous strain imposed upon his delicate health. When Mr. Hooper realized that death was approaching he expressed his keen regret that he could not live to see his brake in commercial operation. He had spent his entire means in experimenting and securing patents in Canada, United States, Great Britain, Italy, New South Wales, Victoria, New Zealand and Belgium.

A test of the brake was made by the Hamilton Street Railway Company on October 10th, 1901. It was found very efficient and satisfactory, and received the endorsation of Mr. E. Wingate, then city engineer, who in a testimonial letter says : "I have no hesitation in recommending it to be a first-class improvement and in every way superior to anything now existing in the line of street car brakes." It is understood that the patents covering the brake will be sold for the benefit of Mr. Hooper's young children.

As the inventor was of a secretive disposition, little is known of this brake by the public. We, therefore, give below a statement of the claims made for it in the original application for a patent dated April 24th, 1899:

IMPROVEMENTS IN ELECTRIC BRAKES.

I, George Henery Bingham Hnoper, of 8 Treford Place, in the City of Toronto, in the County of York, in the Province of Ontario, Canada, electrician, do hereby declare the nature of this invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statements:—

My invention relates to improvements in electric brakes for car and other wheels, and the object of the invention is to design a simple and effectual form of brake shoe in which the lines of force passing through the ends will act with the greatest strength upon the perimeter of the wheel, and it consists essentially of a brake shoe having the major portion of the magnet formed on a circle having a less arc than the contracting pole ends, which are formed concentric to the center of the wheel to which the brake is applied and extend out entirely beyond the wound portion of the magnetic shoe, the parts being otherwise constructed and arranged in detail as hereinafter more particularly explained.

Fig. 1. is a side elevation showing the application of my brake to a wheel.

Fig. 2. is a sectional plan of the brake-shoe and portion of the wheel showing the means whereby such brake-shoe is normally held from contact with the wheel.

Fig. 3 is a detail of an alternative form.

In the drawings like letters of reference indicate corresponding parts in each figure. A is a wheel having an iron rim and designed to be a wheel of a car or other vehicle or wheel on a shaft or any other wheel to which it is necessary to apply a brake. B is my brake-shoe comprising a magnet portion B1 wound as specified and the end contracting pole portion B2. It will be noticed that the pole portions B2 extend outwardly entirely to the outside of the magnet portion B1, and are formed in arcs concentric to the perimeter of the wheel.

The portion 1 it will be noticed is formed on an arc described from a less radius than that of the arcs of the pole ends. By providing outwardly extending pole ends as described the magnet lines of force are allowed a freer passage to the perimeter of the wheel and being entirely outside of the portion B1, there is no danger of short circuiting between the poles as would be the case if the poles approached each other or were close together.

The magnetic brake-shoe is held in position by a link C pivotally connected to the top of the shoe and suspended from a loop D. E are the wires running to the wound portion, which wires are provided at any convenient point with a suitable switch to throw the current into the magnet when desired.

The magnet shoe B is held from lateral displacement by the hanger F, provided with the jaws f between which the shoe fits.

In order to hold the shoe positively free of the ı, provide an electric band f 1 which is passed around the magnet at one end and a hook f 2 on the hanger F at the opposite end.

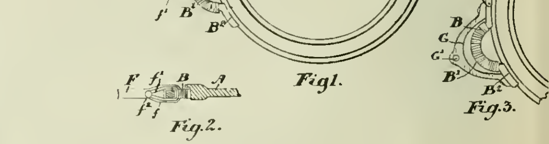
It will be noticed in figure 3 that I provide a straddling bracket G, which I bolt at each end to the core of the magnet. The rod G1 connects the bracket G to the opposite bracket and the brake is supported by a link as hereinbefore shown. The brake levers and shoes will be connected with this rod as in any other brake and such brake could be put on by hand if desired.

It will be seen from this description that by the construction of my brake shoe I am able to procure a much better grip upon the surface of the wheel than of those heretofore devised of which I am aware.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is :—

1. A brake for wheels comprising a bar magnet of uniform cross section throughout, having the wound portion formed in a core the arc of which is that of a circle less than that of the rim of the wheel to which it extends, pole ends extending entirely outside such arc and formed on arcs concentric to the perimeter of the wheel and having their inner arc shaped sides disposed to contact with the wheel as specified.

2. A brake for wheels comprising a bar magnet having the wound portion formed on a core, the arc of which is that of a circle less than the arc of the rim of the wheel to which it extends, pole ends extending entirely outside such arc and formed on arcs concentric to the perimeter of the wheel and having their inner arc shaped sides disposed to contact with the wheel, a link supporting the same pivotally connected at the bottom to the top of the arc shaped pole and thereby leaving the opposite pole end perfectly free and the inner side of both pole ends disposed to contact with the wheel, a rigidly supported guiding hanger having the bottom end embracing the central portion of the core and limiting its movement, and a suitable spring connected to the magnetic brake-shoe at the centre and to a suitable portion of the hanger at the opposite end, as specified.



The Hocper Magnetic Electric Brake.

3. A brake for wheels comprising a bar magnet of uniform cross section throughout having the wound portion formed on a core the arc of which is that of a circle less than that of the rim of the wheel to which it extends, pole ends extending entirely outside such arc and formed on arcs concentric to the perimeter of the wheel and having their inner arc shaped sides disposed to contact with the wheel, and links supporting the bar magnet and the straddle bracket secured to the ends of the core and provided with a cross rod as and for the purpose specified.

QUESTIONS AND ANSWERS

" Reader" : The writer signing himself " Ordinary Reason" in your last issue is not so far wrong. No. 18 old code was ordered out in Montreal a year or two ago and No. 16 (old code) advised in its place. Now No. 16 old code and everything " old code" is ordered out to be supplanted by No. 18 new code (or larger), taking special socket bushings, socket handles, etc., whereas the cord required for portable extension lamps, of which sample is sent, is about as handy as a steamboat hawser. Let the Underwriters have a "competent" inspector, allow him to make the "materials to suit the case," and drop that " pocket directory" of theirs.

Ans.—We do not clearly understand what your objections are. Surely every encouragment should be given to an effort to make wiring more safe, and the increase in the size of the conductor most certainly tends toward that end. Moreover, this end is accomplished without extra cost to those who pay for the wiring, as manufacturers quote the same price on both No. 18 and No. 16 flexible cord. We have not heard of any wiring being ordered out wholesale, as your communication indicates, more especially if accompanied by the substitution of No. 18 for No. 16. The sample you send us is of very poor quality.

" J. W. M." : Would you kindly advise me if you know of any firm in Toronto who manufacture an emergency street car brake.

Ans.—The Momentum Brake Company, Victoria Street, Toronto, manufacture a mechanical brake which is designed like the air system to act as an emergency equipment as well as to be used for ordinary service stops. The Canadian General Electtic Company and other supply companies handle various types of electric brake control which, like the above, are suitable for emergency as well as ordinary stops.

" Engineer" : Will a three phase motor operate off a single phase circuit ?

Ans.—After it has been started it will run and give an output which is about 70 per cent. of that which it will develop if run off a three-phase line, but it will not start itself. You will have to bring it up to somewhere near full speed either by hand or by some auxiliary starting device such as a condenser and compensator, or other phase splitting winding.

Chicoutimi Electric Company, Chicoutimi, Que. : Our system is S. K. C. 2080 volt to 104 volt, by which we run a 30 h. p. 500 volt induction motor of same make. Owing to variations in water wheels the voltage fluctuation is great, causing the fuses on the condensers to blow out frequently. Out of forty plates sometimes 10 to 15 go in a day. What would be the cause ? Should we not use the condensers, or if we should use them what kind of fuse should we use ? The replacing of the fuses means time and labor, and the repairs to the plate are so expensive that the use of this kind of motor does not pay. What would you suggest ?

Ans.—If the fluctuations in your voltage are causing your condensers to break down, the only remedy is either to stop the fluctuations or to put in condensers which will stand up under that service. If the condensers do not break down, but simply take more current when the voltage rises, and thus blow the fuse, we would say that the latter was on the small side, and should be made larger. You will find it scarcely practicable to operate without the condensers ; as the motor will take more current from the generator and will also cause a greater drop in the voltage.

"Subscriber," Montreal : What will be the results if a 60 cycle transformer is operated on a 125 cycle circuit, and vice versa ?

Ans.—The core loss, heating, and magnetizing current will be less, the regulation not quite so good, and the efficiency greater, though you will understand that the practical differences, as viewed from the results obtained in service, are but small. The converse is true on all points for a 125 cycle transformer running on a 60 cycle circuit.

" X. Y. Z," Midland :—What is the difference between a cycle and an alternation ?

Ans.—An alternation is the name given to the movement of an alternating current which, starting at zero, gradually rises to a maximum and then falls, at the same rate, to zero again, flowing during this operation all in the same direction. At the next alternation the current rises and falls in the same manner, but in the opposite direction. At the end of this second movement or alternation the current again starts to flow in the same direction as at first. The first two alternations form a cycle, which as its name implies, covers the round or cycle of operations necessary to bring the current back to where it started from, ready to begin all over again. It will thus be seen that a cycle occupies just twice the time of an alternation, or in other words, consists of two successive alternations.

" Station Superintendent" : What do you consider the best practice in setting the base frames of direct connected dynamos ? Where should the floor be ? What is the best thing to use under the frame to hold it in place ?

Ans.—Unless special conditions render some other elevation desirable, we would make the foundations of such a height as would set the bottom of the dynamo base one to five inches below the floor line, the exact figure depending on the size of the machine. For grouting in you can use the ordinary rust joint, which is made of cast iron borings, sulphur and salammoniac, or else melted sulphur, though perhaps the cheapest and most reliable of all is ordinary cement, of a first-class quality.

" Engineer" : What is the maximum load which an ordinary steam engine will carry, compared with its normal load ?

Ans.—It is very difficult to give any exact figure, as the method of rating adopted by the manufacturer, variation in steam pressure, allowable drop in speed, etc., etc., all affect the result. Speaking generally, we would say that you ought to be able to carry 1½ to 1¾ times the rated load of the engine.

TELEGRAPH and TELEPHONE

WIRELESS TELEPHONY BY THE COLLINS SYSTEM.

By A. Frederick Collins.

While experimenters have been striving for many years to produce a pratical method of transmitting signals without connecting wires they have given comparatively little attention to wireless telephony.

The reasons for this are several, the foremost of which has been due to the fact that the gigantic obstacles in the way of the latter were believed to overbalance its value, e.g., any kind of an electric current, direct, alternating, interrupted or oscillatory, may be utilized in the sending of a message by the dot and dash code, but in the emission, propagation and reproduction of articulate speech an alternating current having the same phase, amplitude and frequency at either end, i.e., syntonized and synchronized, is necessary.

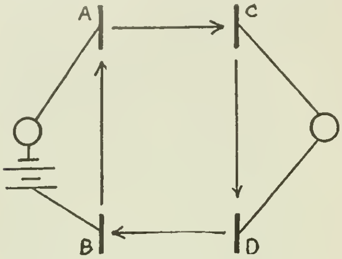


Fig. 1.—Diagram of the Conductivity System.

Again, it is only within the last few years that instruments of the desired sensibility and construction could be obtained, owing to a lack of knowledge of the requirments of the art, and after these matters were partially cleared up the question arose as to whether or not a wireless telephone would have a commercial value, and like many other evolutionary devices there are to-day many engineers who can not see in it the importance attached to it by its inventor. While this is discouraging in the extreme, work has been carried on for the past three years in order to demonstrate to the technician and layman alike that it has a special sphere of action, and this happy day does not seem to be very far distant. It may be argued by some that wireless telephony had been accomplished by others and this is admitted, but before describing the theory and system devised by me let us cast a retrospective glance at the several other methods by which this may be accomplished.

The best known method for transmitting energy to a distance by the natural medium is by the conductivity system and has been in vogue for nearly 100 years; as early as 1825 James Brown Lindsay telegraphed across the River Dee in Scotland. Morse received it in this country in 1842; and by substituting a telephone transmitter and a receiver for the ordinary key and galvanometer or sounder, articulate speech may be carried on.

This is done by arranging four metal plates in parallel, as shown in the diagram, Fig. 1, where AB are connected with a transmitter and battery in series with CD, while the distance between AC and BD represents the distance over which speech or signals are to be sent without wires.

By this method Preece, of England, succeeded in transmitting speech eight miles without connecting wires, but, see now, the conditions which made this experiment possible was a length of wire twenty-five miles long joining AB and CD, so that as far as a commercial wireless telephone was concerned, the imitations began before the practicability of the scheme commenced. Mons. Moche, in his recent experiments at Monte Carlo, and Mons. E. Ducretet, in his tests with wireless telephony at the Catacombs, employed this method.

There is another and far more ideal method for transmitting speech without wires than the one described and in which no earthed connections are used; this is the inductivity method. Preece advocated it for space telegraphy, and by careful deductions it was believed possible to transmit signals— not speech — across the Atlantic Ocean provided a coil of wire large enough to include the whole area of England were suspended on poles, and to include the state of New York within a similar coil, but some exceedingly pretty experiments may be performed in wireless telephony with two coils of wire, represented in Fig. 2, by the side elevation AB, having a considerable diameter and arranged parallel with each other not too many feet apart.

When an intermittent or an undulatory current flows though the coil A, the magnetic lines of force emanate at right angles to the coils themselves, and some of these lines thread through the coil B, setting up currents of the same frequency and amplitude, though the impressed potential and current strength will be, of course, much smaller than the emitted, following the well known law of induction.

Alexander Graham Bell ascertained several years ago that the human voice could be reproduced with exactness by varying the intensity of a ray of light; this was done by causing it to fall on a concave mirror of small diameter attached to the diaphragm of a telephone transmitter, and then, by a series of lenes, concentrating the light and projecting it to a given point where the impinging waves acted on a selenium cell, and this gave rise to varying currents in a local circuit, including a telephone receiver.

Ruhner, of Germany, has improved upon the radiophone to such an extent that he is enabled to send wireless telephone messages a distance of four miles, but the enormous size of the equipment required, and the fact that propagation is impossible unless the transmitter and receiver are in a direct visual line having no intervening obstruction, render it of little more value than the interest attached to it from a scientific standpoint.

Since light waves utilized in the Bell radiophone are of the order of trillions per second it would not seem, on the face of it, to be a very hard proposition to employ Hertzian waves of the order of millions per second, for light waves and electric waves are both transverse vibration and travel with the same rapidity. But theory and experiments have shown wireless telephony to be exceedingly difficult by the Hertzian wave method; this is due to the gradually decreasing maximum of an oscillatory discharge, whereas a pure sine wave is required, and, again, that the oscillations of current are in phase with the vibrations of the diaphragm, the circuit which emits the waves must be slowed down by the addition of capacity and its relation to inductance sustained by the proper coils, when the telephone receiver will respond directly to the waves without a special wire detector in connection with it. Professor Fessenden and the author have both experimented with this form of wireless telephone, and the results are exceedingly interesting from a scientific viewpoint.

Having tested all the above principles to find the one best adapted to wireless telephony, I found a method for obviating the difficulties encountered in utilizing such rapid oscillations as the disruptive discharge of an induction coil produces and without employing condensers or coils for obtaining reasonance in the circuits, but by simple transformation only.

In experimenting with electric waves when employing a coherer adjusted to its maximum sensitiveness I have frequently found that a difference of potential occurs sufficiently great to break down its resistance, when low-frequency, high potential currents surge through the arms of the oscillator system and emit exceedingly long electric waves. The emitted and propagated waves are of necessity long, for the wave length depends on the rate of alternation or period of oscillation, as the case may be, and these reversals of current are bound by the co-efficients of the circuit—inductance, capacity and resistance—and finally these are governed by laws relating to the other.

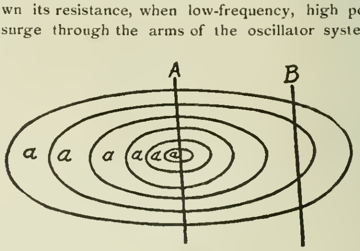


Fig. 2.—Diagram of Inductivity System.—A B Parallel Coils of Wire; a a a a a a Magnetic Lines of Force.

In my system of wireless telephony the discharge of low-frequency, high potential currents is permitted to restore the electrical equilibrium or zero potential in the earth, that is to say. the discharge takes place in the earth, in contradistinction to a disruptive discharge which occurs in free air, and the former produces some phenomena which seem to me to be new.

For instance, the proper inertia for the propagation of electric waves seems to depend largely upon the length of the wave which passes though it. Light waves being exceedingly short find in clouds an obstacle, though red light waves will penetrate fog much more easily than the shorter ones of blue or green because they are longer. Marconi has observed that electric waves, a kilometre or more in length, penetrate fogs with apparent little loss of energy, and the evidence at hand tends to prove that long electric waves will traverse gross matter, like the earth, much more easily than they will free air.

This may be attributed to the apparent modification of ether when related to gross matter, for it is generally accepted that the density of ether when closely allied with an atom of matter is greater than ether in vacua, and the density of the ether surrounding the atoms of which the earth is composed renders it especially conductive to the emitted waves of my wireless telephone transmitter, and the experiments I have made fulfill the requirements of this theory quite nicely.

As an analogue we have in the realm of sound an experiment which will serve to make it clearer. A good many years ago, it may be remembered by some, when it was our wont to go to the "ole swimmin' hole," we would perform a little feat in physics by striking two stones together in the water and the clicking would be heard many times farther and much more distinctly than when struck in free air, for dense mediums transmit sound waves to greater distance than those less dense. On this principle the late Professor Elisha Gray devised his submarine signaling bell.

In a homogeneous medium, such as water, the bound ether will transmit long electric waves farther, better and with less distortion than in a heterogeneous medium such as the earth itself, and so water becomes the best medium for wireless telephony as well as for wireless telegraphy. But wireless telephony is by no means confined to water, and until recently all the experiments and tests were made on hilly lands.

An illustration of my wireless telephone mounted for field work is given in Fig. 3. It includes a transmitter and a receiver. The primary of the sending induction coil is in series with the transmitter, battery, variator and key. The terminals of the transformer are connected to the earth and a compensating capacity. Bridged across the terminals of the secondary is a Leyden jar condenser. The receiver is formed of a closed circuit having the telephone receiver, a single dry cell and the secondary of a transformer in series. The primary of the transformer is earthed as in the case of the transmitting secondary of the induction coil.

In ordinary practice the waves are radiated in every direction, but it has been found possible to direct them within ten or fifteen degrees of arc. Fig. 4 shows how the earth plate is placed.

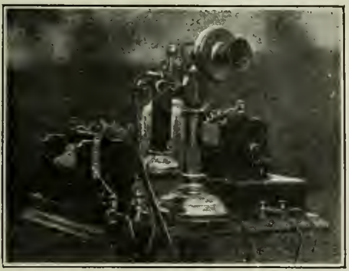


Fig. 3.—Wireless Telephone Portable Transmitter and Receiver.

My experiments in wireless telephony were begun in Philadelphia in the fall of 1899, and in 1900 I sent and reproduced speech electrically through the earth a distance of 200 feet. Narberth, Pa., was then selected as a desirable place for testing stations, and in 1901 apparatus was constructed and tried across the Delaware river at a distance of a mile, and in 1902 this was extended to three miles; the instruments were located on two hills, with a valley, stream, quarry, railroad, telephone and telegraph wires intervening. The reproduced voice was faint, but the articulation was not distorted.

At the present time experiments are being made constantly at Rockford Lake, N.Y., and while it has not been attempted to increase the distance cited above, the instruments have been wonderfully improved with the result that the articulation is clear and loud enough for commercial purposes.

Another feature that has been added in the way of making the system commercial are bells at both stations which are operated wirelessly, and I believe that this is the first complete wireless telephone equipment constructed, operating in both directions, together with signalling apparatus.

The value of wireless telephony lies in its application to speech transmission between vessels, supplanting the time-honored and hoary steam whistle. It may be used in isolated cases where bodies of water intervene and where cables would prove too expensive. It may be used where the right of way can not be obtained for erecting poles or stringing wires; there are a thousand places where it will be welcomed, but as a block signal system for vessels in harbors it will, in my opinion, find its proper sphere of usefulness.

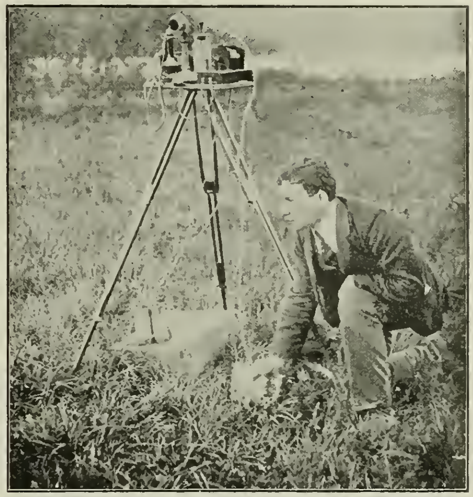


Fig. 4.—Wireless Telephone Field Equipment.—Placing the Earth Plate.

My wireless telephone may never supplant the wire system now in use, but it can to-day be employed where the wire telephone can not be used—on the water and other inaccessible places. Nearly all wrecks are the result of colliding vessels in harbors, due to a misunderstood signal. But when these vessels are equipped with my system—as I hope they may all be soon—the captains will be placed in the same relative position as the modern business man, and they will be able to communicate with each other while sitting in their cabins or from the bridge, instead of relying on a system of signaling that should be relegated to the dead past.—Electrical Review.

SHORT-CIRCUITS.

The People's Telephone Company, of Sherbrooke, Que., purpose improving their system.

Long distance teleohone communication has been established between Winnipeg, Man., and St. Paul, Minn.

Local capitalists at Vancouver, B.C., represented by Mr. D. G. Macdonell, are forming a company for the purpose of installing and operating a new telephone exchange independent of the New Westminster & Burrard Inlet Telephone Company.

The semi-annual meeting of the New Brunswick Telephone Company was held at Fredericton on December 9th, when a quarterly dividend of 1¼ per cent. was declared. During the last six months the company made a large expenditure in building and equipping a new telephone exchange in St. John.

Mr. W. A. Green, local manager of the Bell Telephone Company, at Berlin, Ont., died on December 10th in Toronto, where he was visiting a friend. Mr. Green had been in poor health for some time. He was born in England 57 years ago, being the son of the late William Green, of Chantry, Somersetshire. He assumed charge of the Berlin office of the Bell Telephone Company about four years ago.

COMPARISON OF COMPRESSED AIR WITH STEAM AND ELECTRICITY AT ROSSLAND, B.C.*

By William Thompson.

Compressed air has become so generally used in connection with mining operations, and so well recognized as the most useful and economical power, with its unlimited range of uses, and special adaptability to underground work, that an introductory to this paper on the subject would be superfluous to mining engineers.

The comparative economy of prime movers for air compressing engines is, however, of great interest to all, and a subject on which any engineer can read with interest. This is particularly the case with engineers practising in British Columbia, where a large number of the mining problems include the extraction and reduction of large bodies of low-grade ores and the consequent necessity for a thorough study of economical methods for mechanical handling.

The general mobility of compressed air as a power allows a wide range of generators, or prime movers, but we can, in nearly all cases, rely upon having to adopt primarily one of two sources of power, viz., water or heat.

Water, the first of these, can, as we know, be used in many ways, each terminating finally at the mine, as compressed air ready for service. The initial water power may come from one or more sources situate either at the mines or many miles distant, and can be used either as a directly connected unit of power for the compression of air, or as a prime mover for some intermediary power.

British Columbia has been fortunately blessed with magnificent water powers, more particularly in the Kootenays. In many cases these water powers are situated close to the mines; in others, as at Rossland, they are several miles away.

Distances over which power can be economically transmitted by electricity are yearly becoming greater until it seems that distance is no longer an obstacle, and it has become simply a question of capital investment to successfully transmit the power generated by water almost any distance.

Heat, the second great source of power for the generation of compressed air, has been successfully used as steam for many years, even in places which seemed to be utterly inaccessible either for the erection of the necessary machinery, or the securing of fuel after the machinery had been installed and made ready for operation. So accustomed have we become to surmounting difficulties of this kind, that we are apt to look with suspicion upon any suggestion to utilize distant water powers, preferring to resort to steam as being the power we best understand, and one which has been successfully installed and economically operated under very adverse circumstances.

British Columbia has been abundantly provided with fuel, in fact, we can say the supply of coal is practically unlimited. Enterprising capitalists, year after year, extend railways between the coal fields and the consumers, so that no producing or promising mining district has long to wait for an unlimited supply of this fuel. The mines at Rossland are exceptionally favored in this respect, all the leading mines having access to two lines of railways, and, through them, the coal fields of both British Columbia and the State of Washington.

Rossland is also favored by having the immense water power at Bonnington Falls, less than 40 miles distant, immediately available. The enterprise of Sir Charles Ross and associates in the West Kootenay Power & Light Company have rendered this available for any service at each mine, as a competitor of the steam power, which mine managers would otherwise be compelled to adopt.

The question of the selection of power supply to be made by mine managers at Rossland is almost entirely removed from chance, and may be based on ascertained facts. Railways being at hand for the transportation of any kind of machinery, reasonably cheap fuel in quantities required is assured, and electric power for any size machinery or service is available. Therefore the problem simply resolves itself into "which of these powers will give the best service in operating the machinery used in connection with mining operations?"

The same privilege applies to nearly every other mining district in Southern British Columbia; therefore, the writer feels that the results obtained in the air compressing plants at Rossland will be of special interest to the members of the British Columbia section of the Canadian Mining Institute and mining engineers.

The steam and electric plant described further on were modelled on the design and erected under the personal supervision of Mr. Bernard Macdonald, then general manager of the Le Roi and Nickel Plate mines, assisted by the writer. The steam plant was erected for the Le Roi Mining Company, Limited, and consists of the following, viz.:

Boiler Plants.— Two 250 horse-power Heine safety water tube boilers, arranged to burn coal as fuel. These were intended to generate steam to run the air compressors, and were set so as to work, if desirable, in connection with the 125 horse-power steel shell return tubular boilers, designed to operate the hoisting and surface plants. These boilers are arranged to be interchangeable to either service. A general description of this plant will be found in volume V., page 309, of the Journal of the Canadian Mining Institute.

During the test, the water-tube boilers were used at a gauge pressure of 150 pounds per square inch, using Crows Nest coal as fuel, which cost, laid down in front of the boilers, $5.55 per ton of 2,000 pounds.

Air Compressing Plant.—The steam driven plant consisted of two compound condensing Corliss valve engines, direct connected to two stage air cylinders, equipped with intermediate cooling devices, each machine having a rated capacity of 4000 cubic feet of free air per minute, or a combined capacity of 8000 cubic feet of free air per minute at sea level.

A more detailed description of these engines would be as follows:

	No. 1 Engine. Inches.	No. 2 Engine. Inches.
Diameter high pressure steam cylinder..........	22	22
Diameter low pressure steam cylinder.....	36	36
Diameter high pressure air cylinder.............	22	22
Diameter low pressure air cylinder.....	36	38
Length of stroke	48	48

Intercoolers, horizontal multitubular type; condensors, independent jet.

The Electrically Driven Air Compressing Plant.—This plant was erected by the Rossland Great Western Mines, Limited, and was originally intended to be operated in connection with the steam plant previously described, the intention being to supply power from a central station to four mines, owned by different companies. This arrangement would have given each mine power at the lowest possible cost, and have ensured continuous operations by reason of the compressing plant being arranged in separate units. Each company would pay its share of operation, maintenance of plant, pro rata to its consumption of air.

When it was found necessary to erect the third unit to the compressing plant, unforeseen difficulties presented themselves in the shape of shortage of water for condensing and cooling purposes. On examination, it was found that a satisfactory supply could not be secured without heavy capital expenditures for erection of flumes, etc., to convey the water to where it was required for use.

It was, however, found that a supply of water, barely sufficient for the intercoolers and waterjackets, was available about three-fourths of a mile distant from the steam plant. This supply was so located that it must be either pumped or else the plant located at this distance away from the main steam plant. By conserving this water supply, cooling and re-using, it was decided a sufficient supply of water for the air cylinder jackets and intercoolers could be secured.

The results obtained from the steam plant had proven so satisfactory that it was considered questionable if any electric plant could be installed that could successfully compete with steam, even when running non-condensing, unless very favorable rates for power could be secured. After negotiations with the power company it was decided to erect an electrically driven plant, a short description of which is as follows:

Electrical Equipment. —Three phase, S.K.C., synchronous motor, designed for 2200 volts, with a rated capacity of 660 kilowatts, equivalent to about 825 horse-power. The motor is provided with a separate starting motor, mounted on the main frame, exciter and Italian marble switch-board, on which all operating switches and instruments are mounted.

There is a 54 inch Frisbee clutch set intermediate between the driving pulley and the motor. The motor is of a four bearing type, fitted with self-aligning and self-oiling sleeves. The entire machine is mounted upon a solid cast iron base set upon massive concrete foundations. The driving pulley is 60 inches in diameter, grooved for 22 1½ in. ropes, and runs at 270 revolutions per minute.

---

*Paper read at the Nelson meeting of The Canadian Mining Institute.

The three compressors were built by the Canadian Rand Drill Company, of Sherbrooke, Quebec, and are especially designed for constant service.

The electrical equipment is also entirely of Canadian manufacture, the entire apparatus being manufactured by the Royal Electric Company, of Montreal, who were the Canadian manufacturers of the S.K.C. apparatus.

All tests were conducted under the personal supervision of the writer, and extreme care was taken to arrive at actual facts. Indicator diagrams were take off both the steam and air cylinders every half-hour, and the results tabulated. Coal consumed was weighed, and all other supplies, such as waste, oil, etc., charged as used.

Readings were also taken and recorded by means of a delicately adjusted kilowatt meter, connected to the primary mains, of the amount of electric power used. The test extended over a period of thirty days, without interruption, both plants being run under exactly similar conditions as to air pressure.

Each of the plants tested being modern and representative of their respective types, gave an opportunity for a comparative test that rarely falls to the lot of an individual engineer under such favorable conditions, as to work being performed, and for this reason is the more valuable as data for basing calculations as to problems of power.

The average results of the thirty days' test is recorded in tables I, II, III, IV and V following:—

TABLE I.

Work Performed by Steam Plant.

Average indicated horse-power at steam cylinders of the combined machines	730 h.p.
Free air compressed per minute from atmospheric pressure to 95 lbs. per square inch	5432 cu. ft.
Free air compressed per hour	325,920 cu. ft.
Average horse-power required at steam cylinders to compress 100 cubic feet of air per minute, to gauge pressure	13.4 h.p.
Pounds of coal consumed during test	1,038,000 lbs.
Pounds of coal consumed per day of 24 hours	36,400 lbs.
Average pounds of coal consumed per horse-power per hour during test	1.9 lbs.

TABLE II.

Work Performed by Electric Plant.

Average horse-power registered at switch-board	540 h.p.
Free air compressed per minute from atmospheric pressure to 95 pounds gauge pressure	3,319 cu. ft.
Free air compressed per hour	199,140 cu. ft.
Average horse-power required at motor to compress 100 cubic feet of free air per minute to 95 lbs. gauge pressure	16.3 h.p.

TABLE III.

Cost of Operating Steam Plant.

Total cost of fuel consumed during test	$2,880.45	
Total cost of wages for employees	710.00	
Total cost of oil, waste, etc	147.30	
Total cost for 30 days, exclusive of maintenance and depreciation		$3,737.75
Cost per horse-power per month for fuel	3.96	
Cost per h.p. per month for oil, etc.	0.20	
Cost per h.p. per month for wages	0.97	
		$5.15
Cost per h.p. per annum		$61.56
Cost for each 100,000 cubic feet of free air compressed		1.56
Cost per drill shift		1.25

Note.—80,000 cubic feet taken as the average consumption per shift of one 3¼ in. drill.

TABLE IV.

Cost of Operating Electric Plant.

Cost of current for 30 days	$1,744.26	
Cost of employes' wages	270.00	
Cost of oils, waste, etc	73.00	
Total cost for 30 days exclusive of maintenance and depreciation		$2,087.86
Average cost per horse-power per month		3.87
Average cost per horse-power per annum		46.44
Cost for each 100,000 cubic feet of air compressed		1.46
Cost per drill shift		1.17

Note.—80,000 cubic feet taken as the average consumption per shift of one 3¼ in. drill.

TABLE V.

Showing comparative results between the two types of compressors, based on each 100,000 cubic feet of air compressed from atmospheric pressure to 95 lbs. receiver pressure :

Cost for each 100,000 cubic feet of free air compressed by steam plant (see Table III)	$1.56
Cost for each 100,000 cubic feet of free air compressed by electric plant (see Table IV)	1.46
Result, saving by electricity over steam	6.4 per cent.

The saving shown in Table V would be affected adversely if the electric plant was operated singly and the entire air compressed was not used, for the reason that electrically driven compressors must be operated at constant speed, and loss of air at safety valve would be considerably increased over the same loss at steam plant, which could be run at the speed required to compress the amount of air actually required. This loss would, however, be slightly off-set by the increased cost per horse power by working the steam compressors on underload.

I wish to draw special attention to the noteworthy results obtained from the system of intercooling used on the compressors tested.

In Table I it is shown that the steam plant required 13.4 horse power to compress 100 cubic feet of air to 95 pounds gauge pressure per minute. The best power factor recorded that has come under the writer's notice, for doing the same amount of work by a two stage compressor, is 14.5 horse power, which shows a saving of 8 per cent. resulting from the use of specially designed intercoolers, for which the manufacturers are entitled to receive the credit.

How this result is obtained can be best understood by reproducing the average of a number of tests made on the efficiency of the intercooler during the progress of the power test. The results of these tests are shown in Table VI.

TABLE VI.

Temperature of cooling water at inlet of intercooler	42 deg. F.
Temperature of cooling water at outlet of intercooler	50 deg. F.
Rise in temperature of cooling water while passing through intercooler	8 deg. F.
Temperature of air at outlet of low pressure cylinder and before passing through intercooler	196 deg. F.
Temperature of air at inlet of high pressure cylinder after passing through intercooler	54 deg. F.
Reduction in temperature of air after passing through intercooler	142 deg. F.

In conclusion, permit me to state that this paper has not been prepared with the idea of recording the performance of these two plants, except in so far as comparisons can be drawn between the relative efficiency of the two systems, so that engineers, knowing local conditions, can have some record of actual performance before them.

MOONLIGHT SCHEDULE FOR FEBRUARY.

Day of Month.	Light.	Extinguish.	No. of Hours
	H.M.	H.M.	H.M.
1	P.M. 5.40	P.M. 6.15	12.35
2	" 5.40	" 6 15	12.35
3	" 5.40	" 6.15	12.35
4	" 11.00	" 6.15	7.15
6	" 0.15	" 6.15	6.00
7	" 1.15	" 6.15	5.00
8	" 2.15	" 6.15	4.00
9	" 3.00	" 6.15	3.15
10	" 4.00	" 6.15	2.15
11	No Light.	No Light.	....
12	"	"	....
13	A.M. 6.00	A.M. 9.15	3.15
14	" 6.00	" 10.30	4.30
15	" 6.00	" 11.30	5.30
16	" 6.00	" 12.30	6.30
17	" 6.00	" 1.30	7.30
18	" 6.00	" 2.30	8.30
19	" 6.00	" 3.20	9.20
20	" 6.10	" 4.10	10.00
21	" 6.10	" 5.00	10.50
22	" 6.10	" 5.45	11.35
23	" 6.10	" 5.45	11.35
24	" 6.10	" 5 45	11.35
25	" 6.20	" 5.45	11.25
26	" 6.20	" 5.45	11.25
27	" 6.20	" 5.45	11.25
28	" 6.20	" 5.45	11.25
		Total	211.50

MONTREAL

Branch office of the Canadian Electrical News,
Imperial Building.

Montreal, January 8th, 1903.

The question of supplying heat has apparently been shelved for the present by two of the electric companies. The Standard Electric Company, which has been affiliated with the Lachine interest for some years, and which in consequence drives its d. c. power generators by means of a c. motors furnished with current from the latter company, thought that they might use to advantage their boilers standing idle, to do commercial heating. It seems that their charter from the legislature gives them (so they claim) the right to open up the streets to "pipe" for that purpose. The point was also quickly taken up by the Montreal Light, Heat and Power Company, who claim similar charter privileges, and who had the steam plant of the Royal Electric Company at their disposal, as the Chambly dam now delivers the necessary electric current. Accidents, however, have shelved matters, at least for the present, first owing to the price of coal as the result of the iniquitous coal strike, and secondly owing to a break in Chambly dam. The Montreal Light, Heat and Power Company have not only brought into requisition the steam plant of the Royal Electric Company at their disposal, but have leased for a time that of the Standard Company as well.

The dark mornings during the last month, coupled with dismal days and early evenings, must have caused abnormal bills for lighting, but if all the complaints re. electric meters were listened to, one would imagine that such a piece of apparatus is not yet manufactured that comes within 80 per cent. of being correct.

Rumors are again strong anent an amalgamation of the Lachine Rapids and Montreal Light, Heat and Power Companies. The advice of the old folks that two "heads" are better than one may be taken.

Strange how the press know so much about Marconi's successes or failures at Glace Bay, when it is a fact that no one except his own trusted operatives are allowed inside the works and no information has as yet been given. News "guessed at" is apt to look ridiculous in the future—especially is this so with regard to electrical inventions.

It is high time that a word of caution was given the public regarding the small lamps operated by batteries, and more especially by miniature dry cells which any one electrically versed knows are for open circuit work only. They may be meant to be "flashed" only, but the average purchaser does not do so, ruins his battery in no time, then rails at small electrical devices in general indiscriminately.

The fire at the residence of Mr. A. A. McKenzie, Sherbrooke street, which the press unitedly stated must have been caused by electric wires, is only one more of the usual. There was not one iota of proof or reason for laying the cause to electricity, and competent experts have put the blame on a grate in a room which was used pretty continually during the cold snap.

Query: Lots of soft coal is being consumed in Montreal this winter, and stoked by those paterfamilias who have been used to anthracite in the past. If electricity is to be blamed for all the fires this winter, it will undoubtedly be bearing the "white man's burden" with a vengeance.

DOMINION INSTITUTE OF AMALGAMATED ENGINEERING.

At a meeting of the Dominion Institute of Amalgamated Engineering held recently at the office of the Secretary, 32 Church Street, Toronto, the effect of two recent decisions, the one by the judicial committee of the Privy Council and the other by the Supreme Court of Canada, affecting the patent law of Canada, was under discussion, and the following resolution was unanimously adopted: That the Government be asked to repeal the present Patent Act and to substitute therefor an act similar to that of the patent law of the United States. A committee was appointed to take action in the direction of the legislation recommended by the meeting.

A PROGRESSIVE ELECTRIC COMPANY.

Gradually the electric railway is becoming a factor in the interstate traffic of passengers. With two or three changes it is now possible to go from Buffalo through portions of the states of New York and Pennsylvania, Ohio and Michigan, an almost continuous electric line around the south shore of Lake Erie to Port Huron. On some stretches of this route the cars run half-hourly, and all at least hourly. The best portion with the closest connections is between Port Huron and Detroit, the cars all being luxuriously fitted up with velvet plush covered seats. Everything appears up-to-date under the management of Mr. Wood.

The power houses along the route furnish an abundant supply of electric energy. At Port Huron the power is generated by the Port Huron Power & Light Company, of which Hon. Henry McMorran is president, Mr. W. F. Davidson (the well-known expert electrician) being secretary and treasurer, and Mr. James Davidson superintendent and manager.

Port Huron claims to be the very first place on this continent to run an electric railway, consequently one is partly prepared to see a good plant. The Port Huron Light & Power Company furnish 700 h.p. each to the Port Huron Mfg. Company and the Engine and Thresher Company, also to the street car lines, incandescent and arc-lighting plant.

This company were the first to establish enclosed arc-lights. The plant is of the 500 volt 3 phase system. They can step up to 10,000 volts and step down to 200 volts, using 3 phase alternating induction machines. The whole plant is one the neatest and cleanest in America. The company are now building an exact duplicate plant to increase their present capacity. The new 2,000 h.p. turbine will be directly connected with a 500 kilowatt, 3-phase, 60 cycle, 1100 volt G.E. generator. In this plant are also the following: Two 500 kilo-watt direct current generators of the Westinghouse type (for street car service); two 300 kilo-watt, 60 cycle, 1100 volt, 3-phase G.E. machines; two 120 light Brush arcs; six T.H. 50-light arc machines; two 62-kilowatt 500 volt D.C. generators; one 500 h.p. Westinghouse compound engine; one 500 h. p. Ball engine, cross compound; one 1000 h.p. Russell tanden compound; three double battery 500 h.p. Sterling boilers, and one 250 h.p. same make. The new plant now going in will just double the above.

The condensing sett consists of rotating water pumps, air pumps and small pumps to take care of the overflow from the hot well, all of the Alberger type. The condensing outfit must maintain 28 inches vaccum, and was built expressly for the Port Huron Compony.

IMPORTS OF ELECTRICAL APPARATUS.

According to the trade and navigation returns, the value of electrical apparatus imported into Canada during the fiscal year ending June 30th, 1902, was $1,373,022, an increase over the preceeding year of $453,168. The duty paid thereon was 25 per cent. on generators, motors, batteries, telephone and telegraph instruments, etc., 15 per cent. on carbons over six inches in circumference, and 35 per cent. on carbons of smaller dimensions. The details are as follows:

Generators, motors, and sockets—from Great Britain, $2,422; United States, $330,492.

Electrical apparatus not elsewhere specified — from Great Britain, $12,470; Newfoundland, $15; Austria-Hungary, $49; Denmark, $24; France, $177; Germany, $2,758; United States, $918,637.

Electric light carbons over 6 inches in circumference—from France, $153; United States, $47,933.

Electric light carbons and carbon points, of all kinds, not elsewhere specified — from Great Britain, $296; France, $10; Germany, $3,456; United States, $25,360.

Telephone and telegraph instruments — from Great Britain, $557; France, $130; United States, $28,083.

The Commercial and Financial World, of New York, states that Judge Coxe, of the United States Circuit Court, has granted a perpetual injunction against the Keystone Electrical Instrument Company restraining the latter from manufacturing and selling electrical measuring instruments claimed to be an infringment upon the Weston instruments. The essence of the decision is that the Weston Electrical Implement Company have the sole right to manufacture alternating current measuring instruments based on the dynamometer principle.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

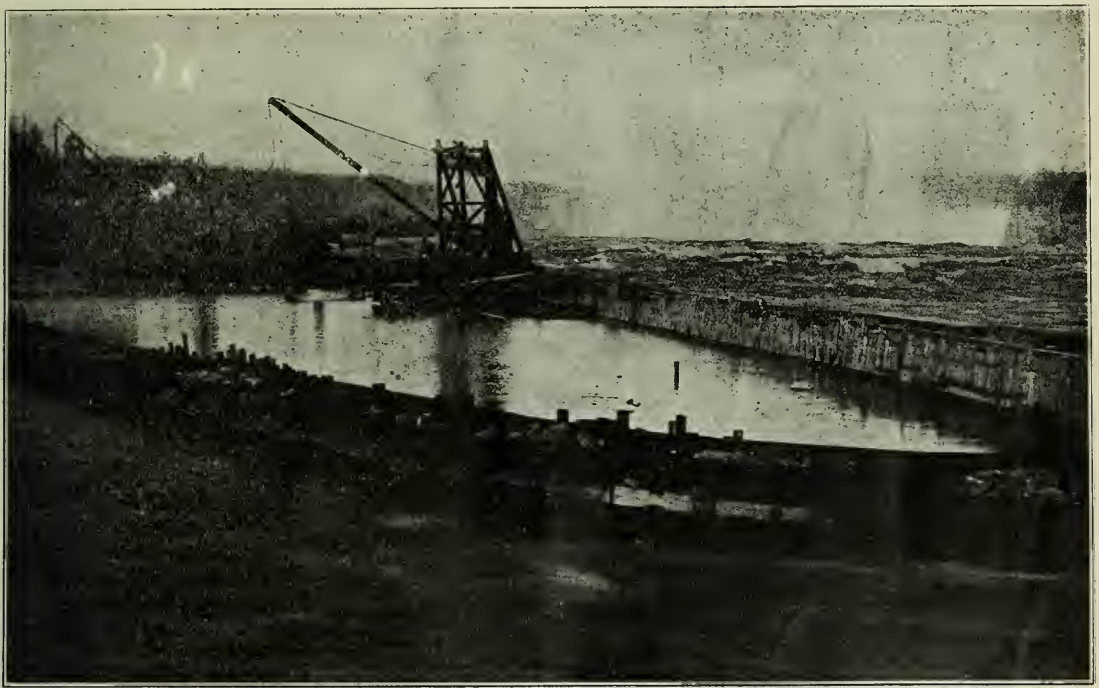
VOL. XIII. FEBRUARY, 1903 No. 2.

THE CANADIAN NIAGARA POWER DEVELOPMENT.

In no part of the Dominion of Canada are the power resources of that country undergoing more active development than on the Canadian side of the Niagara Falls. The site of this development is in Queen Victoria Park, a plot of ground lying close by the Horseshoe Falls and acquired for pleasure purposes, in order that mankind might view the stupendous spectacle of the mighty cataract untaxed. The spirit of industry is, however, creeping into the pleasure plot confines, and already two companies have acquired franchise rights, allowing them to develop large blocks of power, while a third company is now having its application considered by the government.

The companies which now have franchises are the Canadian Niagara Power Company and the Ontario Power Company, while the Toronto Niagara Power Company's application is pending. The Canadian Niagara Power Company is practically the same as the Niagara Falls Power Company, which company owns the remarkable development at Niagara Falls, N. Y.

At one time this company controlled the exclusive privilege of developing power in Victoria Park, but saw fit to relinquish the exclusive features of its franchise, since which time the other companies have sought for rights there. The locality of the development is ideal, and it is possible to develop a very large amount of power, but it should be stated that all the power developed must be transmitted beyond the park limits for commercial application. In other words, the industrial sites will be outside the park, while a portion of the developed force will be transmitted to the New York side of the river.

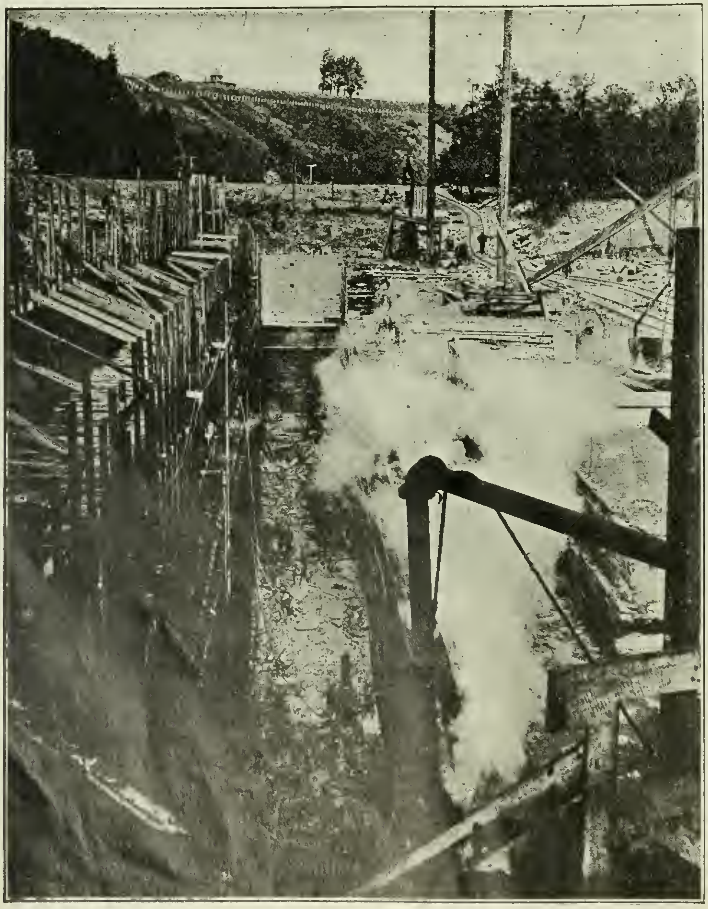

BUILDING A NEW INTAKE TO THE WATERWORKS, NEAR THE BRINK OF THE HORSESHOE FALLS, CANADIAN NIAGARA POWER COMPANY.

THE CANADIAN NIAGARA POWER COMPANY.

Inasmuch as the method adopted by the Canadian

Outer End of the Big Wing Dam, Ontario Power Company.

Niagara Power Company for its development practically the same as that of the Niagara Falls Power Company, it will have the advantage of the latter company's valuable experience, both in the construction work and in perfecting the marvellous installation that is prospective. Thus the Canadian Niagara Power Company is sinking a wheel pit and building a tunnel tailrace to carry the water from the wheel pit to the lower river. The site of the wheel pit is less than 2,500 feet back from the crest of the Horseshoe or Canadian Fall. The plan calls for a wheel pit 480 feet long, but at present the section being built is 266 feet long, 21 feet wide and 170 feet deep. The contractors are Messrs. Dawson & Riley, of St. Catharines, Ontario, and it is intimated that the same firm of contractors is about to receive an additional contract for extending the pit to its full contemplated size. The wheel pit is being sunk through solid rock, the conditions of the excavation being very similar to those found in the construction of the two big pits on the New York side by the Niagara Falls Power Company. The pit has reached the depth of 130 feet. The sides are channeled, making it probably the biggest job of channeling ever done in the Dominion.



New Wheel Pit of the Canadian Niagara Power Company, to be Lined with Brick.

The progress in sinking the wheel pit is about twelve feet a month. Dawson & Riley have also the contract for building the forebay and canal in connection with the pit work. This forebay will be the full length of the pit, and will flare out in front of it to a point where it will be crossed by the tracks of the Niagara Falls Park and River Railway. At this point it will narrow down to a canal-like section, later flaring out toward the river. The electric line referred to will cross the forebay on a stone arch bridge that is expected to be the finest structure of the kind in the Niagara locality. It will have a length of 250 feet, and will be erected in five arches of graceful size and style. It will have a width of sixty feet. The forebay will carry an average depth of eighteen feet of water. The bridge is being built by Mumford & Lowery, of Niagara Falls, Ont. From the north end of the forebay, near the wheel pit, a canal sixteen feet wide and 500 feet long will be built to serve as an icerun, the flow to be regulated by gates.

The tunnel that will carry off the discharge from the turbines will be 2,200 feet long, 25 feet high and 18 feet wide at the spring line. It will be observed that it is four feet higher than the big tunnel on the New York side, but its length is less than a third of the original Niagara power tunnel. Anthony C. Douglas has the contract for the construction of the tunnel, and has driven it through the rock from the pit to the face of the cliff. The portal is located very close to the base of the Horseshoe. Contractor Douglas is now removing the bottom bench of the tunnel. It was originally intended to line the tunnel with brick, similar to the lining of the New York tunnel, but a scarcity of brick has forced the adoption of concrete for a portion of the lining, and for this reason concrete is being used from the spring line down. This application of concrete will do away with the use of at least 3,000,000 brick. However, brick will be used in lining the arch, and 250,000 will be so placed, while the concrete lining will be faced with vitrified brick. The brick is obtained from Beamsville, Ontario. The rock excavated from the bottom bench is used in making the concrete. Twenty thousand barrels of Lehigh cement will be used in making the concrete. To indicate the further great consumption of material, it may be pointed out that over 2,000,000 feet of timber were used in timbering the tunnel, that sixty carloads of granite and 200 carloads of Queenston, Ontario, limestone will be used in the masonry work about the portal of the tunnel. The portal being located so close to the falling waters of the Horseshoe it will ever be under the influence of the spray of summer and the ice of winter, features that demand unusual construction work.

Contractor Douglas' plant consists of two compound, duplex, 125-horse-power Ingersoll air compressors; one 400-horse-power motor to operate them, the current being transmitted from the New York side; twelve drills; two Lidgerwood hoists, with double drum; one Otis elevator lift at the shaft, ten by sixteen feet, located midway between the portal and the pit; one rock-crusher, and other incidental equipment.

Dawson & Riley's plant consists of 750-horse-power boiler capacity; two compound Rand air compressors of 250 horse-power each; eight Sullivan channeling machines; two gadders and eight drills of Ingersoll make, and two ten-ton Brown locomotive hoists.

In the two plants of the Niagara Falls Power Company the development is made in units of 5,000 horse-power. On the Canadian side, in the plant of the Canadian Niagara Power Company, the unit of development will be 10,000 horse-power. When the development on the New York side at Niagara was projected, men in the interested professions could hardly wait the operation of machines of such wonderful output capacity, and now a similar feeling exists in regard to the installation of the Canadian Niagara Power Company. In the wheel pit there will be ten turbines, each of 10,000-horse-power output capacity, making the total proposed development by the pit 100,000 horse-power. Contracts for three of these wonderful turbines have been placed with Messrs. Escher, Wyss & Company, of Zurich, Switzerland. In design they will be similar to those installed by the Niagara Falls Power Company in wheel pit No. 2, the wheels in which are of the Francis, or inward discharge type.

The generators to be installed in the Canadian power station will be wound for 12,000 volts, three-phase, twenty-five-cycle-current, and will make 250 revolutions per minute. This will give a uniformity with the plant on the New York side, permitting of parallel operation. The generators will be of the internal revolving field, vertical-shaft type, and the revolving parts of the machines will weigh 141,000 pounds. The General Electric Company will build the generators. They will be about nineteen feet in diameter. In adopting a unit of 10,000 horse-power for the Canadian-Niagara development, the Canadian Niagara Power Company will effect lower cost of generator per horse-power, and lower cost of turbine per horse-power, while in using this unit there is a saving in cost of construction for a given output in the matter of the wheel pit, station, etc. Toronto is a prospective market for a portion of the current generated at Canadian-Niagara, and for transmitting such distances the voltage will be increased by step-up transformers to 22,000, 40,000 or 60 000 volts.

THE ONTARIO POWER COMPANY.

In the development of its prospective 100,000 horse-power the Ontario Power Company will erect a plant similar to that of the Niagara Falls Hydraulic Power and Manufacturing Company on the opposite side of the river. However, instead of having a surface canal to conduct water from the upper river to its power station it will lay one or more large pipes through Victoria Park, close along the base of the bluff that skirts the park in the rear. The company's forebay will be well up the river above Dufferin Islands, and there will be a gate house at the foot of the forebay. The pipe line referred to will convey the water supply to a point below the Table Rock house, at which point the water will pass into penstocks that will carry it down the bank to the power station, which will be located at the water's edge in the gorge. This power station will be but few hundred feet distant from the Horseshoe, and will be the nearest building ever erected in the gorge to that great eye feast of falling water. The site is now being excavated, and a large portion of the debris has been cleared by the use of giant powder and dynamite. In this work the rock was thrown out in the river in order that the expense of handling it might be thereby lessened. So far this company has not announced the style or type of the generators or wheels to be adopted in its development.

In preparation for its forebay construction the Ontario Power Company has thrown a long wing dam out in the river above Dufferin Islands. This dam is nearly 800 feet long, and a splendid piece of work. It has had the effect of diverting all the water that heretofore flowed about the Dufferin Islands, and that section of the river bed is now quite dry and will remain so until the construction work in that locality has been completed.

The resident engineer of the Canadian-Niagara Power Company is Mr. Cecil B. Smith, while Mr. Wm. A. Brackenridge, of the Niagara Falls Power Company, is consulting engineer. Mr. Brackenridge has had extended experience in the Niagara power development, and Mr. Smith is an engineer of well-known ability.

THE TORONTO-NIAGARA POWER COMPANY.

The Toronto-Niagara Power Company has only recently made application to the commissioners of Queen Victoria Park for the right to develop power to the extent of 100,000 horse-power in the park. It is understood its plan of development contemplates the construction of a wheel pit and tunnel.

During the progress of the work of the Canadian-Niagara Power Company the excavated material from the tunnel shaft and wheel pit has been used in filling in various places in order that the locality might be beautified. At one spot an embankment has been built out to the very edge of the Horseshoe Fall, and when this is riprapped and carefully graded it is expected to be a great improvement, while also forming a delightful scenic point of view.—Orrin E. Dunlap, in the Electrical Review.

ELECTRICAL DEVELOPMENT IN THE WEST.

Electric light and power promises in the near future to become much more universally employed throughout Western Canada. Several municipalities in Manitoba are now installing electric lighting plants, and the equipment of new office buildings, elevators and industrial establishments frequently includes an electric plant for lighting and power purposes, Closely associated with this development is Mr. E. S. Harrison, electrical engineer, of Winnipeg, who is interested in several electrical undertakings in the west. One of these is the construction, by the Suburban Rapid Transit Company, of an electric railway between Winnipeg and Headingly, a distance of twelve miles. The grading and bridging for one-half the distance was completed last year, and it is intended to lay the rails and ties this spring and to have the road in operation by the summer.

Mr. E. S. Harrison.

Mr. Harrison is installing a complete plant at Carman, Man., for the Carman Electric Light & Power Company, of which he is a director. This plant will consist of three 65 horse-power boilers manufactured by the Vulcan Iron Company, of Winnipeg, and two 65 horse-power and one 35 horse-power Robb-Armstrong engines direct connected to two 40 k.w. and one 20 k.w. 250 volt, direct current, Western Electric generators. One unit and one boiler has already been set up, and the balance of the plant will be installed early in the summer. Over 700 lights have been wired and the balance will be connected up as fast as the wiremen can execute the work. A plant similar to the above will be installed this spring at Minnedosa.

At Banff Mr. Harrison is installing in the C. P. R. hotel two 50 h. p. Ideal engines direct connected to two 30 k.w., 125 volt, Western Electric generators.

Among other installations which have been placed in the hands of Mr. Harrison may be mentioned the following: Forty k.w. 125 volt generator, direct connected to 65 horse-power Ideal engine, in the Strathcona Block, Winnipeg; one 15, one 10, and one 5 horse-power, 500 volt motors, with Cutler-Hammer speed regulator, in the Codville Spice Mills, Winnipeg; 9 k.w. 110 volt generator, in the Leland Hotel, Winnipeg; 32 Petite alternating enclosed arc lamps in departmental store of Robinson & Company, Winnipeg; wiring of new elevator and the Kaministiquia Hotel at Fort William, Ont., for the Canadian Pacific Railway, and wiring of two elevators at Port Arthur, Ont., for the Canadian Northern Railway.

THAWING OF WATER PIPES BY ELECTRICITY.

The thawing of frozen water pipes by means of electricity is a possible source of revenue for central stations which has as yet received little attention. An exception is the Tagona Water & Light Company, of Sault Ste Marie, Ont., which has for some years derived considerable revenue from this work. The idea originated with Mr. William Gorby, electrician of the company, who read an article by a college professor stating that water pipes could be thawed out very quickly by causing an electric current to traverse that part which is frozen. He immediately proceeded to make a test, with mostsatisfactory results.

The accompanying illustration of the apparatus used shows a 250 k.w. transformer mounted on a sleigh, this transformer being used because at the time a smaller one was not available. Generally all the pipes in the town can be thawed out by a 500-light transformer, but two of these are ample to thaw out any pipes likely to get frozen. The primary wires (2,200 volts) are bared and the current led through a water rheostat to the transformer. An ammeter shown in the engraving indicates the load on the transformer primary. The secondary is connected to the frozen pipe at two places and the current switched on. In the ordinary house service pipes the water begins to flow very quickly, frequently within a minute.

The charge for thawing pipes depends altogether on each individual case, varying usually from $3 to $5 and occasionally reaching $10, depending on the size of the pipe and the length of time necessary to thaw it out. The largest pipe yet thawed out was a four-inch cast iron pipe, which was frozen more or less for 200 feet. It took at least half an hour to get the water running. It is said that this method of thawing water pipes has resulted in a large saving to the citizens of Sault Ste Marie.

Apparatus Usdd for Thawing Water Pipes at Sault Ste. Marie, Ont.

QUESTIONS AND ANSWERS

"Enquirer": What is the difference between the commercial and the electrical efficiency of a dynamo or motor?

Ans.—The latter takes into account only the losses which are purely electrical, such as the resistance of the conductors, and the core losses. Commercial efficiency includes not only these, but in addition the various mechanical losses which exist in every machine, for instance the friction of the brushes, windage, and the friction of the bearings.

"Student": What is meant by power factor?

Ans.—In alternating current work the current and voltage are very seldom in phase with each other, if they are not their product does not represent the true power, which is less by an amount depending on the extent which the current leads the voltage or lags behind it. The factor by which their product has to be multiplied to get the true power is called the power factor. Thus, if the power factor of a circuit carrying 10 amps. at 1000 volts is 85%, the true power is 10 x 1000 x .85 or 8.5 k.w.

"Subscriber" writes: How can a circuit of 17 street lights 32 c.p. each, be arranged from power house on a circuit of 1040-110 volts alternating current?

Ans.—17 lamps on a 1040 volt circuit means 1040÷17=61 volts per lamp. Assuming that they are of an efficiency of 3½ watts per candle, each lamp will take 32x3½=112 watts, 112÷61=1.83, which is the amperage consumed by a 112 watt 61 volt lamp. Therefore, you can operate 17 32 c. p. lamps in series from a 1040 volt circuit if you make them of 1.8 amps. capacity. You will note that this is a special lamp, which will take longer to obtain than standard sizes. Further, you will likely find your voltage is 5 or 10 per cent. higher than 1040, in which case one or two extra lamps, installed in the power house, and equipped with short circuiting switches, will enable you to compensate for this increased pressure and thus save burnt out or strained lamps.

"Engineer": A compound wound dynamo when thrown into parallel with two other shunt wound machines does not take any of the load. What is likely to be the difficulty?

Ans.—It may be due to one of two causes, either your series field is reversed, or else the driving power is not sufficient to keep up the speed, in which event it will drop and thus lower the voltage and consequently the load the machine takes. We would suggest that you connect the series coils the other way; if this does not remedy the trouble examine all your belts, pulleys, etc., perhaps there is something loose or slipping.

"Reader": I note your remarks in regard to my enquiry and believe you have taken a wrong view of the case. Changing 16 old code to 18 new code does not increase the size of conductor; on the contrary it decreases it and this is the safety paradox referred to. The insulation of new code is somewhat thicker than old code, but surely this alone does not warrant retroactive action. The question of inspection in Montreal is pecular, the Underwriters will not appoint one, claiming it is the function of the city, whereas if the latter did appoint one, municipal politics would probably figure in the appointment to such an extent that the Underwriters would not recognize the appointee. Hence the rules "as read" are enforced by general inspectors of the Underwriters, and of individual insurance companies.

Ans.—You are quite correct in saying that changing from No. 16 to No. 18 is decreasing the size of the conductor, but we referred to the first case of "ordering out," of which "Reader" spoke, namely, the substitution of 16 for 18. As we said before, we have yet to hear of a case of wholesale changing in the equipment of a building in order to make it correspond exactly with a change in the Underwriters rules. New work is supposed to be put in according to those in force at the time the contract was let, old work being passed as it is unless it is notoriously deficient in any of the more essential points.

"Winnipeg": What are the main points of difference between surface and jet condensers? Which type is most suitable for use with steam turbines?

Ans.—In the former the steam is condensed by coming in contact with surfaces, which are kept cool by water on the other side of them, the steam and the water being kept separate all the time. On the other hand, in the jet type, as its name indicates, the steam is condensed by means of a jet of water which is directed into it, the two mingling at the point of entry into the condenser and being discharged therefrom as one. This latter type is, on the score of economy, much to be preferred for use with any type of steam motor, whether reciprocating or rotating, as it uses much less water than the other type. This advantage is sometimes outweighed by the fact that the steam coming from an engine of the former type contains a large amount of oil, and therefore if a jet condenser be used the discharge has to be filtered before being sent to the boilers. This is not the case when turbines are used, as the steam from them contains no oil, nor yet when the ordinary steam engine is controlled by a surface condenser where, as stated above, the condensing and condensed waters are kept separate.

"J. L.": Can a standard compound wound generator be used as a booster? If so how will it compare with a proper machine built for that purpose?

Ans.—As a general rule any compound dynamo can be operated as a booster, but depending on the particular machine in question you may or may not get satisfactory commutation, especially if you desire to carry an amperage which approaches the normal load of the armature. Further than this, depending on the amount of series winding on the fields, you may not be able to get sufficient boosting effect. Compared with a proper booster the main points of difference will be, as above, the possible poor commutation and lack of sufficient voltage, together with the fact that your voltage will not be exactly proportional to the current passing, which is considered a most important point. You will also note that owing to the fact that your field magnets are not nearly saturated even at the highest loads, your machine is unneccessarily large and heavy, which in turn means that your efficiency is poor.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.

BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.

22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.
1ST VICE-PRESIDENT:
EDWARD SLADE, General Superintendent Jacques Cartier Light & Power Co., Quebec.
2ND VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.
SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.
EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A. B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
ORMOND HIGMAN, Chief of Electrical Inspection Department, Ottawa.
ED. A. EVANS, Manager Quebec Railway, Light & Power Co., Quebec, Que
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
A. SANGSTER, Manager Electric Light & Power Co., Sherbrooke, Que.
A. A. WRIGHT, M. P., President Electric Light & Power Co. Renfrew Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON,	Toronto.
Vice-President, CHAS. MOSELEY,	Toronto.
Treasurer, A. M. WICKENS,	Toronto.
Registrar, J. G. BAIN,	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN,	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER	Baden Ont.
Vice-President, H. E. TERRY	Toronto, Ont
Secretary, W. INGLIS,	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont.
Conductor, J. STRUTHERS,	Sarnia, Ont.
Door Keeper N. BEAN,	Waterloo, Ont.

A New Converter. The announcement is made that Mr. Peter Cooper Hewitt, whose name is familiar to electrical men through the exploitation of the mercury vapor lamp which he has perfected, has been successful in producing a chemical process for the conversion of alternating into direct current. Briefly the system consists in passing the alternating current through a vessel containing certain gases or vapors which allow the passage of the current in one direction, but which oppose it when in the other. It will at once be seen that the apparatus has an enormous field before it if it can be made commercial, seeing that it requires no more attendance than the ordinary oil-cooled transformer, and weighs only some two per cent. of the standard rotary. The information which up to the present has been made public is extremely vague, though some wonderful predictions have already been made on it, but it does not yet appear that the owners of patents on rotary converters are losing any sleep over the possibilities of the latest arrival.

The Salesman of the Future. The time is now plainly in sight, if it be not here already, when the salesman for electrical companies can no longer secure large and lucrative business owing purely to his personal relations with the customer and his ability to make himself generally hail fellow well met. In the early days of any rising industry, and electricity has been no exception to the general rule, the personality and individuality of the salesman, rather than the intrinsic value of the apparatus he had to offer, were the main and dominating features deciding the closing of many large contracts, the prices, in the light of the figures obtaining to-day, being fabulous, as were also the estimated capabilities of the apparatus concerned. To-day the practice is much changed, the buyer has learnt to a great extent to discriminate between reasonable statements and guarantees and claims which commercially are entirely incapable of fulfilment. This increase of knowledge on the part of the purchaser must be catered to by a corps of salesmen who possess, to a corresponding degree, technical information concerning their own and their competitors' machinery. That this demand is being met is evidenced by the ever increasing number of men on the selling staffs of the various manufacturers who, in addition to their commercial education, have had considerable engineering training, both theoretical and practical.

A Novel Transmission Line. The plans for a 105 mile transmission plant, to be installed in Mexico, which are now being prepared, cover some rather novel ideas in line construction. Instead of wood poles, spaced at the ordinary distances of 90 to 150 feet apart, steel towers are to be used, placed on 440 feet centres, which is a large increase over the distances commonly used to-day. As the line potential will be 60,000 volts, there is to be but one three wire transmission line to each set of towers, repairs to a dead line being out of the question if there is another line working at that potential on the same pole. This decrease in the number of poles per mile, of course, means a corresponding reduction in the insulators, by which means it is hoped to decrease the amount of trouble, as each of these latter forms a weak spot in any transmission line. In view of the increased length of the spans it is proposed to use a stranded cable instead of the usual solid line wire. The conductivity will be equal to a No. 1 B & S gauge. Steel pins and steel cross arms will be used, otherwise any defect in an insulator would mean the destruction of the pin and possibly that of the arm as well, with its attendant damage to the pole, whereas if they are metallic any breakdown simply becomes a short circuit without damaging anything but the insulator and possibly the wire itself. From the above it will be seen that the line, if installed according to the methods now proposed, will be radically different in many points from what is to-day considered standard practice, and one whose cost of building and results of operation will be watched with interest.

Standards for Direct Connected Units.

Notwithstanding the fact that the best methods of attaching to each other the engines and generators of direct connected sets, and also the question as to the most advantageous sizes and arrangements of the various parts of either machine which affect the other, have been discussed time and again by the more prominent steam and electric manufacturers and by the engineering societies and technical press concerned, there still remain many features which, undecided and indefinite, increase the cost of production of the unit and leave open an avenue for mistakes, which when they occur are all the more annoying because, falling as they do between the manufacturer of the engine and that of the dynamo, the responsibility can never be definitely placed on one or the other. As instances may be cited solid shafts versus couplings, notably in the case of centre crank engines, where the shipping of the shaft round the country, especially if the armature be attached, is very likely to result in a sprung crank pin; the minimum size of shaft desired by the engine builder which in side crank engines at any rate is frequently objected to by the dynamo manufacturer as "too large for our standard armature spider", the responsibility for the supplying of the shaft key, the outboard bearing, the attaching bolts, for the labor of pressing on the armature, etc. Efforts have been put forth by the American Society of Mechanical Engineers to formulate such standard practice as will assure the elimination of any and all possible mistakes and misunderstandings between the customer, the electric company, and the engine builder, the reduction of costs, and thus give its members a better hold upon their present markets and a greater chance to secure new ones. Does it not behove our various Canadian manufacturers to get together along the same lines, and thus retain their natural market, which will otherwise be secured by their more enterprising competitors?

Nernst Lamp.

The Nernst lamp has long been a favorite theme for technical journals and engineering societies, but the time has now come when it will have to be taken into account as a commercial article. A number of plants in the United States have put in more or less experimental equipments during the past year, and have obtained results which will doubtless warrant large increases. Some of our Canadian companies are now making tentative purchases, and as the apparatus becomes better known among consumers they will in all probability put more and more lamps into commission. This lamp, while retaining some of the features of the arc, approaches much more closely the incandescent. The light is emitted from a conductor raised to the proper temperature, similarly to the hot filament of the latter, except that it is not enclosed in a vacuum. As opposed to the flickering of an arc it gives an absolutely steady illumination, very much resembling the usual Edison lamp. The light emitting part of the lamp, or glower as it is called, is a non-conductor until raised to a certain temperature, and to do this or start the lamp, an auxiliary circuit containing the heater is provided, which is cut out as soon as the glowers get hot enough to let current flow through them. In addition to the steadiness and pleasing color qualities of the light, it accomplishes a great step forward in efficiency, which is about 1¾ watts per candle, as against 3 for the incandescent type. It also has the further merit of being easier to build for 220 volts than 110, which, much as it is desired, is not yet true of the arc or incandescent types. It is usually manufactured to-day in sizes ranging from one glower, rated at 50 c. p. and consuming 88 watts, to 6 glowers producing 300 c. p. and taking 530 watts. The life of the glowers, which are very easily renewable, something after the style of the carbons in an arc lamp, varies considerably, being materially affected by voltages higher than normal, the same as is an incandescent filament. In Europe the apparatus has been developed for use on direct current circuits only, while on this continent the practice has been entirely opposite, the equipment at present on the market being adapted for nothing but alternating currents. The average life appears to be somewhere about 800 hours for 60 cycles, which is decreased by 50 per cent. for 25 cycles, and increased approximately a corresponding amount for frequencies of 125. In appearance the lamp is very similar to a small arc lamp, though equipped with a standard Edison incandescent base, and furnished with a closed base globe, adopted for either indoor or outdoor use, forming a very pleasing combination.

BRITISH COLUMBIA ELECTRIC RAILWAY.

The report of the directors of the British Columbia Electric Railway Company, submitted at the annual meeting on January 21st., covered operations of fifteen months, from 1st. April, 1901, to 30th. June, 1902. For this period the gross receipts were $691,487, being $80,369 in excess of those for the corresponding previous period. The working expenses were $426,760, an increase of $52,929, and the net earnings were $264.727, an increase of $27,440.

The chairman recommended certain improvements, such as the renewal of six miles of track with heavier metal on the Victoria division, increased rolling stock, and the erection of rolling stock building yards. It was stated that a considerable amount of profitable freight business had to be refused during the past six months.

The Electrical Construction Company, of London, Ont., have installed an electric motor in the printing office of the Observer, Sarnia, Ont. It is a 500 volt machine operating at 1,500 revolutions per minute.

MOMENTUM RAILWAY BRAKES.

Since the general introduction of electric transit, the need of a more efficient brake than the old style hand brake has become increasingly apparent. Cars have increased in size and weight, larger loads are carried, speeds have increased, and a motorman makes a far larger number of stops per day than did the driver of an old time horse car. All this means a greater demand on the strength and physical energy of the motorman under all conditions, and it means, further, that under some conditions the hand brake is entirely incompetent to prevent disaster.

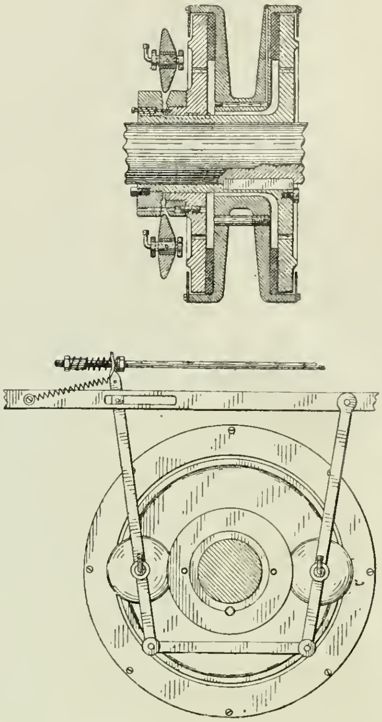


Fig. 1.—Cross-Section of Momentum Brake.

Various devices have been introduced to provide more efficient braking power. Some have increased the braking leverage, but, necessarily, this means loss of time in applying the brakes.

Air brakes have had considerable vogue. In individual compressor air brake systems each car is equipped with an electrically operated compressor. Such air brakes use expensively generated and transmitted power, which can often be ill spared when a car is a long distance from the power house. Storage air brake systems mean the maintenance of several compressor plants at different stations, and the loss of time in replenishing the storage tanks of cars, particularly of those operating in sections on which the stops are frequetn.

The principle of the momentum brake is worthy of explanation. By a momentum brake is meant one which utilizes the power stored up in the car's momentum to apply the brakes for a stop. This power has to be dissipated in some way before the car can stop, and it is evidently a most rational proceeding to use part of this power in applying the brakes instead of trying to dissipate it all in the form of friction between the brake shoes, the wheels and the rails.

The brake made by the Momentum Brake Company, Limited, 34 Victoria street, Toronto, under the T. E. McCollum patents, is a momentum brake which has proved successful in practice. As will be seen by referring to the illustrations, and particularly to Fig. 1, the brake comprises a friction disk formed on a sleeve secured to the axle, a second friction disk sliding with a feather key on the sleeve, and a flanged drum journaled on the sleeve between the friction disks. On this drum is wound the chain connected to the brake levers. On the disks are secured annular friction surfaces of compressed wood fibre which engage the sides of the drum. The flanges of the drum overlap the friction disks and have annular plates secured to them to exclude dust and form an oil bath for the friction surfaces.

On the end of the hub is secured a bevel sided collar, and the hub of the movable friction disk is similarly beveled to form with the collar a V-shaped grove, with which the taper wheels shown may be engaged to force the friction disks and drum into contact. The method of supporting and applying the taper wheels will be understood from the illustration. Attention must be called, however, to the coil compression spring arranged between the taper wheel lever and the horizontal rod which is operated by chain from the ordinary brake staff. This spring is claimed to ensure the elastic application of the brake in such a manner as to avoid jarring and skidding.

With this brake there is a direct mechanical connection from the motorman's hand to the wheels, and he can actually feel what the latter are doing, so that he can always apply just the amount of force to the brakes necessary to give the best braking effect without skidding, and in this the spring aids, as it prevents the actual hard and fast locking of the wheels.

In applying the brake the manufacturers claim that about a quarter turn of the brake staff suffices to bring the friction surfaces of the brake into contact, after which a third of a revolution of the drum applies the maximum power of the brake. This makes the brake very effective in emergencies. But, as the effective friction of the friction surfaces depends entirely on the power applied by the motorman, the stops may be made as easy as may be desired for service purposes.

In this connection it is important to note that the friction surfaces of the brake are set as far from the axle as possible, while the winding surface of the drum for the brake chain is as close as possible. This not only increases the powsr of the brake owing to the great leverage of the friction surfaces, but makes the brake steadier in action and responsive to small variations in the power applied to it by the motorman.

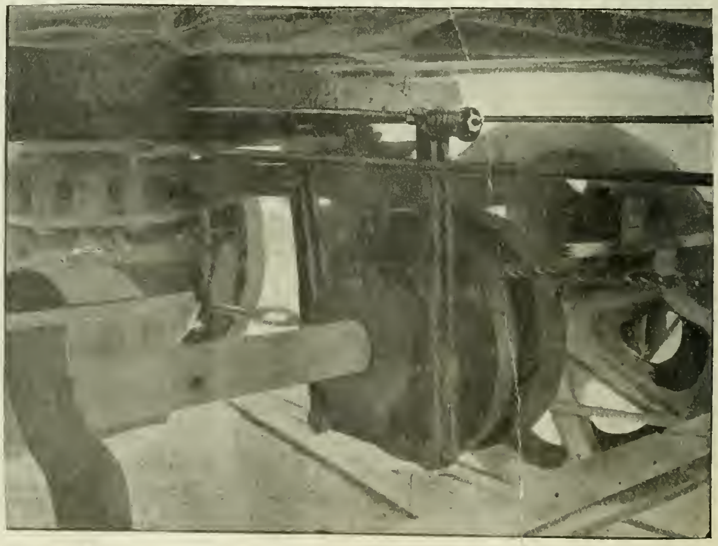


Fig 2. — Momentum Brake Mounted on Spare Axle of a Double-Truck 22-Ton Car.

The brake complete weighs 280 pounds. Its greatest diameter is 10 inches, and its greatest width 8 inches. The width can, however, be materially reduced to suit special cases. The annular fibre friction surfaces are 2½ inches wide and present 236 square inches of friction surface. The taper wheels are of steel, 5½ inches in diameter. The brake goes on the axle beside the motor and is easily fitted to any car.

One of the most important features of the brake does not show in the cuts, viz., the device for preventing "back-roll."

It has been urged against momentum brakes that, if the brake be released and then re-applied while the car is on a grade, it will not grip to hold the car until the chain has been unwound from the drum and then rewound the reverse way. This "back-roll" might amount to nearly eight feet. In the McCollum brake the connections between the brake mechanism and the brake staff are said to be so arranged that under the circumstances described the motorman, by merely reversing the movement of the brake staff, is enabled to catch the car and hold it before "back-roll" commences.

The brake has been severely tested in actual service. The Toronto Railway Company have twenty-three on their cars; the Niagara, St. Catharines and Toronto Railway Company are using five, and the International Transit Company, of Sault Ste Marie, Ont., have equipped their entire system with these brakes.

One brake in constant use for 15 months in Toronto is claimed to have cost only $2.50 for oil, repairs and maintenance, and to have given entire satisfaction to the company and to the men handling it, and the car has never been in the shops with flat wheels. The cost of the brake is comparatively small.

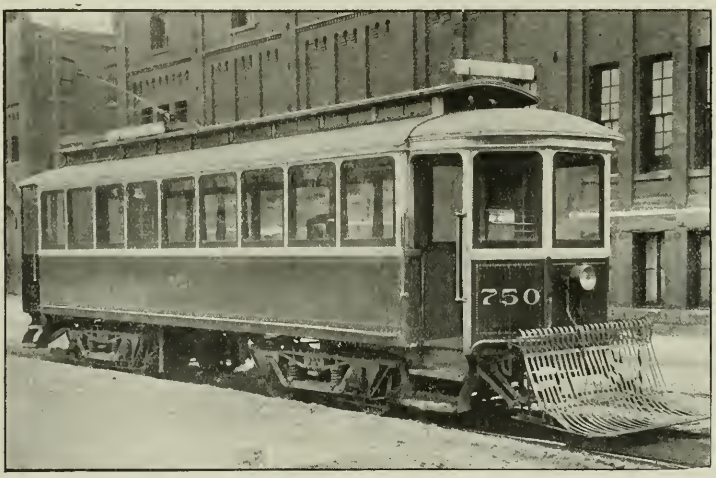


Fig. 3.—Doucle-Truck Four Motor Car, Equipped with Momentum Brake.

ELECTRIC PLANT AT ANDREWSVILLE.

Andrewsville, also known as "The Flats," is a small village situated on the Rideau River, fifteen miles east of Smith's Falls and two and one-half miles below Merrickville. At Andrewsville there are three Government locks, also two Government dams for keeping the water at a level in the canal. The Kemptville Milling Company also own a dam about one-quarter of a mile below the Government dams, which has been brought into service to furnish power for an electric plant which they have just installed. There is a ten-foot head of water operating two seventy-four inch latest improved Leffel Wheels manufactured by Madison Williams, of Port Perry. These wheels are set in a concrete flume 20x40 feet. The concrete walls are four inches thick, sixteen feet high and built on solid rock bottom.

A space under the wheels has been blasted to the depth of 10 feet by 18 by 36 feet, with an incline for the tail-water to leave the wheels. In order to be able at any time to raise the dam to secure more head, there have been placed on the water-wheels two upright shafts eighteen feet long made of six inch steel. Situated on each upright shaft is a six foot crown wheel. There is also a lay shaft thirty-six feet long, of five inch steel, with friction clutch cupplings on each wheel in order to cut any wheel out as required. There is on each lay shaft an eleven-foot wood split pulley, thirty-six inch face, manufactured by the Dodge Company, of Toronto.

The power-house is built over wheels and flume the dimensions being thirty-six by forty feet and one-storey high. The foundation for generator is built on the solid rock below flume, 18 feet high 10 by 12 feet at the top, of concrete. On this foundation has been placed a 300 k.w. three-phase generator, driven by a thirty-four inch double leather belt, and generating ten thousand volts, also a 14 k. w. exciter, which is sufficient to excite the generator and furnish direct current lights to the village of Andrewsville. The generator and all electrical apparatus was manufactured by the Canadian General Electric Company, of Peterborough. In the building is also located high potential switch-boards, ampere meters, volt meters, oil switches and lightning arrestors placed on marble panels.

From Andrewsville the power is transmitted to Kemptville over a fourteen mile transmission line, composed of three No. 6 hard drawn bear copper wires, strung on poles from thirty to thirty-five feet in length, one wire on top of poles and the other two on cross-arms. The wires are twenty-one inches apart. The insulators are of the Knowles umbrella type, sufficient to insulate for 200,000 volts. Three miles below the power house is the village of Burritts Rapids, which it is intended to light.

The pole line follows the main road, crossing the Rideau river and canal at Burritts Rapids. On the same pole line there is a metallic telephone service of two wires, transposed every five poles, for the company's use.

At Kemptville there is a brick sub-station for the step-down transformers which reduce the voltage from 10,000 to 2,300, also high potential switch-board, switches and lightning arresters and all other necessary apparatus. The sub-station is situated 100 feet from where the company have a one hundred barrel flour mill and seventy-five barrel oatmeal mill, where there have been installed two 200 horse power boilers and two corliss engines of 125 h.p. and 100 h.p., also 1,500 alternating current dynamo, which furnishes the village of Kemptville with lights, running on 2,000 volt primary and 110 volt secondary. The streets are lighted with forty 32 candle power series lamps, besides the commercial lighting. This latter machine is also of the Canadian General type and was installed about four years ago.

The company intends leaving their steam plant in tact for an auxiliary plant. They are also installing in the dynamo room a 100 h. p. induction motor of 2,300 volts to run the flour and oatmeal mill from the power plant at Andrewsville.

Several factories of Kemptville are anxious to obtain power and there promises to be a demand for all the available current. The chief electrician is Mr. John Maxwell, and associated with him are Mr. Rolf, of Ottawa, and Mr. James O. Hyndman. The plant is about to be put into operation.

AN ANALYSIS OF THE COMMERCIAL VALUE OF A WATER-POWER.*

By A. F. Nagle.

The writer recently testified in court as to the value of water-power per horse-power per annum in a manner that may be of interest to our membership. The subject-matter has been discussed heretofore in our society, but I am not aware that precisely the same analysis has been given before. The problem is quite a familiar one to New England engineers. The river flow is assured to certain abutting parties by old legislative grants, and is usually used for power purposes. Any town or city taking water from this stream is liable for damages incurred by reducing the available power of said stream of water. The amount of power existing in the stream at each mill, expressed in horse-power per second, as well as the amount taken, or diverted, by the city, and affecting the particular mills, is a problem for hydraulic engineers which I do not take up; but the value of the water power at each mill is a problem which I have attempted to solve. I have formulated my studies under three theorems, which I believe express the true principles under which the problem can be solved, with as much certainty as the cost of a steam-power.

Theorem 1. The value of water-power, when of ample capacity or a specific purpose, does not exceed the cost of what a competing power, steam or gas engine, can be installed and operated for at the same locality.

Theorem 2. When a water-power is insufficient for a specific purpose, due to the varying flow at different seasons of the year, and its limited amount, then its value is reduced from that established by Theorem 1, by the cost of installing and operating a steam plant to make good this insufficiency.

Table I.—Annual Cost of Steam-Power per Indicated Horse-Power.—Compound Condensing Engine.

Horse-Power.	400	500	600	700	800	900	1,000	1,200	1,500
Cost of plant per I.H.P.	$64.00	$60.00	$57.50	$56.00	$55.50	$55.00	$54.60	$54.00	$53.00
Annual interest, etc., at 10 p.c. per I.H.P.	6.40	6.00	5.75	5.60	5.55	5.50	5.46	5.40	5.30
Cost of banking (no heating), repairs, supplies, engineer, etc., per I. H. P.	7.30	7.60	7.75	7.80	7.95	7.70	7.55	7.50	7.50
Annual (3,060 hrs.) cost of coal at $4.50 per long ton per I. H. P.	12.30	11.40	10.50	9.85	9.50	9.30	9.25	9.25	9.20
Total annual cost per I.H.P.	26.00	25.00	24.00	23.25	23.00	22.50	22.26	22.15	22.00

Table II.—Annual Cost of Steam-Power per Indicated Horse-Power.—Simple Condensing Engine.

Horse-Power.	50	75	100	150	200	250	300	400	500
Cost of plant per I.H.P.	$90.00	$75.00	$65.00	$57.00	$51.00	$47.00	$45.00	$43 00	$42.00
Annual interest, etc., at 10 p.c. per I.H.P.	9.00	7.50	6.50	5.70	5.10	4.70	4.50	4.30	4.20
Cost of banking (no heating), repairs, supplies, engineer, etc., per I. H. P.	9.00	8.50	8.20	8.30	8.60	8.30	7.90	7.85	7.80
Annual (3,060 hrs.) cost of coal at $4.50 per long ton per I. H. P.	25.00	22.00	20.00	17.00	15.30	15.00	14.60	13.85	13.00
Total annual cost per I. H. P.	43.00	38.00	34.70	31.00	29.00	28.00	27 00	26.00	25.00

Theorem 3. The damages to be paid annually, or capitalized at—per cent. if made in one payment, for a given amount of diverted water-power is the value of the water-power as found by Theorem 2, plus the depreciation in the value of the remaining water-power.

The cost of power is an element in all productive industries, and whether it be a large or small element, the mill (we will call it) demands a certain amount of power, the cost of which, if a steam plant, can be calculated quite closely, probably within 10 per cent. It is the interest of the mill owner to obtain his power at the least possible cost to himself, and he stands in the position of a buyer of power before the power-producing public. Two sellers may offer him power—a steam-power producer, or a water-power producer. Because the mill owner in New England is generally also a water-power owner, does not change the relation of the power consumer to the power producer, a buyer and a seller, and for a clear understanding of this complex problem, it is absolutely necessary to separate the two parties in any analysis that may be applied to the problem under consideration.

The annual cost of steam-power per horse power, including every item except land, can be calculated by an experienced engineer for any particular locality with reasonable accuracy. In Tables I. and II. I have given my estimates of engine plants ranging from 50 horse-power to 500 horse-power, single-condensing engines; and from 400 horse-power to 1,500 horse-power compound-condensing engines located along the Blackstone River, New England. These estimates are generally large, but as the items appear both in the minuend and subtrahend of the calculation, the remainder, resulting in the value of the water-power, is not so seriously affected thereby. The result, however, of these large figures for steam-power is to increase the value of the water-power. The items comprising the tables are all so well known to engineers that it is needless for me to comment upon them. Nor is it so much my purpose to establish the accuracy of these particular items, or their results, as it is to establish a principle, or method, of calculating the value of a water-power for power purposes, and thereby take the problem out of the domain of prejudiced guesswork.

Theorem 1 is almost a self-evident proposition. No mill owner as a buyer of power will pay more for water-power than he can install and operate a steam plant for. He would not even give as much as that, because if he had water-power only, he would have to install a boiler plant for heating and other auxiliary uses; while if he had a steam plant, he could supply himself with this additional steam at a comparatively small cost. For present purposes, however, I shall neglect this fact.

Theorem 2 is not quite so obvious. Very few water-powers are of sufficient power to supply the large mills they drive with ample power every day in the year. At times there is an excess, and at other times it is quite insufficient. It is at this point that a clear understanding must be had of the relation of the mill owner to the water-power owner. It is not the business of the mill owner to meddle with the problem of this varying and insufficient water supply. That difficulty belongs entirely to the water-power owner. In order to make the water-power commercially available, in order to give it any value at all to the purchaser of power, in order to give it what it has been pleased to call "a market value," "a commercial value," he must supplement the fluctuating water-power with steam-power. The maximum possible price obtained for the combined steam and water-power has been fixed by the cost of a single steam plant. Hence the less the steam-power costs him the more he will get for his water-power. This will be more fully illustrated by detailed calculations hereafter.

Theorem 3. This theorem is perhaps more theoretical than practical, for in few cases is the quantity of water diverted from a stream sufficiently large to affect perceptibly the quantity remaining. It is, however, a fact that repeated diversions constantly diminish the value of the remaining power; and it is proper that this depreciation of the remaining power should be paid for at each diversion. This would seem to be a principle of equity, and I have investigated the application to a particular case upon a rather extravagant hypothesis.

To illustrate the practical application of the theorems here advanced, one mill and its power diagram has been selected from the testimony in the suit. The river flow in horse-power per minute for every month in the year is established at the mill by hydraulic engineers employed in the suit. The amount of the diverted power at the mill is also given by said engineers, but is too small to appear in the diagram, Fig. 1. The amount of power required to operate the mill, and the wheel capacity, are given by the mill owner. Referring to Fig. 1, the power of the river flow is seen to vary greatly. This mill requires an average of 900 horse-power per annum. The water wheel is of only 743 horse power, and the mean annual water-power is 690 horse-power, requiring a steam-power of 210 horse-power to give the 900 horse-power to the mill. The low stage of the river is such that a 370 horse-power steam plant will be required at times.

MAXIMUM EFFICIENCY OF A WATER-POWER PLANT.

Referring again to Fig. 1, it is quite evident that a large wheel-power would have been conductive to a greater value of the water-power. For the purpose of ascertaining the greatest value of a water-power by the rules laid down in this paper, let us assume that the minimum flow is as shown in the figure. In that case water of 530 horse-power would be supplied every day in the year, and if it could be brought about that a mill required just that amount of power, the water-power would be worth $25 per horse-power (see Table I.) and the water owner would receive a revenue of $13,250 per annum. On the other hand, if the mill still requires 900 horse-power, and only 530 horse-power wheel-power were available, then the calculation would stand as in Table IV.

---

*Slightly Condensed by the Engineering Record from a paper read before the American Society of Mechanical Engineers.

TABLE III.—WALLEY FALLS COMPANY.

Required mill-power	900	H.-P.
Average water-power	690	"
Average steam-power	210	"
Maximum steam-power	370	"
Time engine runs	12	months
Full annual cost of 900 H.-P.C.C. plant at $22.00		$20,250
Annual interest, etc., 370 H.-P.S.C. at $4.40	$1,628	
Annual supplies, etc., 370 H.-P.S.C. at $7.85	2,904	
Annual coal, 210 H.-P.S.C. at $14.00	2,940	
Total cost of 210 H.-P. steam	$7,472	7,472
Cost per H.-P.	35.60	
Value of 690 H.-P. water		$12,778
Value of 1 H.-P. water	$18.52	

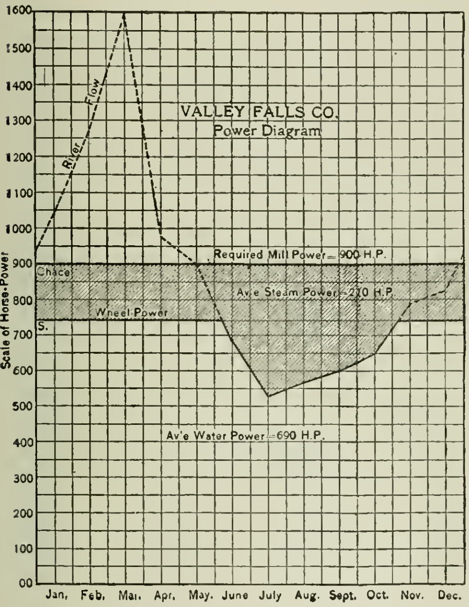


FIGURE 1.

TABLE IV.

Required mill-power	900	H.-P.
Average water-power	530	"
Average steam-power and maximum	370	"
Full annual cost of 900 H.-P.C.C. plant at $22.50		$20,250
Annual interest, etc., H.-P.S.C. at $4.40	$1,628	
Annual supplies, etc., 370 H.-P.S.C. at $7.85	2,904	
Annual coal, 370 H.-P.S.C. at $14.00	5,180	
Total cost of 370 H.-P. steam	$9,612	9,612
Cost per H.-P.	26.00	
Value of 530 H.-P. water		10,538
Value of 1 H.-P. water	$19.88	

Now let us go a step further, and under the same conditions and requirements put in a 900-horse-power-wheel. Then the calculations will stand as in Table V.

TABLE V.

Required mill-power	900	H.-P.
Average water-power	764	"
Average steam-power	136	"
Maximum steam-power	370	"
Time engine runs	7½	months
Full annual cost of 900 H.-P.C.C. plant at $22.50		$20,250
Annual interest, etc., 370 H-P.S.C. at $4.40	$1.628	
7½ mos' supplies, etc., 370 H-P.S.C. at $7.85	1,815	
Annual coal, 136 H.-P.S.C. at $14.00	1,904	
Total cost of 136 H.-P. steam	$5,347	5,347
Cost per H.-P	39.32	
Value of 764 H.-P. water		14,903
Value of 1 H.-P. water	19.54	

Hence, we see that a mill requiring 900 horse-power with a river flow as indicated by Fig. 1, can be supplied with power by water-power owner in one of two extreme ways. If he puts in only 530 horse-power wheels running every day in the year at this power, he will receive $10,538 net for his water, but he must spend $9,612 for steam-power in order to obtain this amount for his water. If, on the other hand, he would put in a 900-horse-power wheel and spend $5,347 for steam, albeit it costs at the rate of nearly $40 per horse-power, he will receive nearly $15,000 per annum, or $19.54 per horse-power.

MONTHLY VERSUS ANNUAL AVERAGES.—There is some question as to the accuracy of determining the average annual value of the water-power by the annual average, or calculating it separately for each month in the year. I have made an estimate of said values as applied to Fig. 1, by monthly estimates, and compared it with the annual average which has been used throughout these calculations. I have also introduced a corrected value of coal due to underloading of the engine, and embodied the result in Table VI.

TABLE VI.

Power required at mill	900	H.-P.
Cost of steam H.-P. per annum		$22.50
Cost of coal per H.-P. per annum		9.30

Monthly H. P.	Cost of steam per H.-P. uncorrected.	Cost of coal per H.-P. corrected for underload.	Cost of steam per H.-P. corrected.	Value of Water per H.-P. based upon Col.4.
160	$42.32	$17.50	$45.82	$17.47
160	42.32	17.50	45.82	17.47
160	42.32	17.50	45.82	17.47
160	42.32	17.50	45.82	17.47
160	42.32	17.50	45.82	17.47
220	34.60	16.00	36.62	17.94
350	27.00	14.00	27.00	19.67
330	27.72	14.00	27.73	19.47
300	29.11	14.50	29.61	18.95
240	32.89	15.50	34.38	18.18
160	42.32	17.50	45.82	17.47
160	42.32	17.50	45.82	17.47
210	37.30	16.38	39.67	*18.04
210	35.60	14.00	.....	†18.52

---

*Annual average by monthly estimate. †Annual average by yearly estimate.

Column 1, Table VI, is the average monthly steam-power, column 2 is the cost of this steam-power as found by preceeding methods, column 3 is the corrected cost of coal per annum for an underloaded engine, column 4 is the annual cost of steam-power based upon coal value in column 3, and column 5 is the final value of water-power based upon steam cost in column 4.

It will be seen that while the cost of steam-power (210 horse-power) based upon a yearly average is $35 60 per horse-power, it is increased to $37.30 per horse-power it made upon a monthly basis; and if also corrected for coal, becomes $39.67 per horse-power; and the value of water-power is reduced from $18.52 to $18.04, which is less than one would have supposed it to have been, and yet it is the correct way to pursue.

SUCCESSIVE DIVERSIONS.—The amount of water diverted is usually very small in proportion to the total quantity in the river. To illustrate in detail the manner of calculating the value of the water-power per horse-power per annum when large quantities of water are taken at several intervals instead of all at one time, I have applied the calculation to a water privilege substantially like that of the Valley Falls Company, Fig. 1, where, say, 100 horse-power is taken at each interval, until it is all taken. Tne results are given in Table VII.

TABLE VII.—FIRST CASE, ORIGINAL CONDITION.

Required mill-power	900	H. P.
Average water-power	700	"
Average steam-power	200	"
Maximum steam-power	400	"
Time engine runs		12 mos. always
Full annual cost of 900 H.-P. C.C. at $22.50		$20,250
Annual interest, etc., 400 H.-P.C.C. at $6.40	$2,560	
Annual supplies, etc., 400 H.-P.C.C. at $7.30	2,920	
Annual coal, 200 H.-P.C.C. at $12.30	2,460	
Total cost of 200 H.-P. steam	7,940	7,940
Cost per H.-P.	39.70	
Value of 700 H.-P. water		12,310
Value of 1 H.-P. water	17.60	

SECOND CASE.

Required mill-power	900	H. P.
Average water-power	600	"
Average steam-power	300	"
Maximum steam-power	500	"

Full annual cost of 900 H.-P. as before		$20,250
Annual interest, etc., 500 H.-P. C.C. at $6.00	$3,000	
Annual supplies, etc., 500 H.-P. C.C. at $7 60	3,800	
Annual coal, 300 H.-P. C.C. at $11.40	3,420	
Total cost of 300 H--P. steam	10,220	10,220
Cost per H.-P.	34.07	
Value of 600 H.-P. water		10,030
Value of H.-P. water	16.72	

THIRD CASE.

Required mill-power		900 H.-P.
Average water-power		500 "
Average steam-power		400 "
Maximum steam-power		600 "
Full annual cost of 900 H.-P. as before		$20,250
Annual interest, etc., 600 H.-P. C.C. at $5.75	$ 3,450	
Annual supplies, etc , 600 H.-P C.C. at $7.75	4,650	
Annual coal, 400 H.-P. C.C. at $10.50	4,200	
Total cost of 400 H.-P. steam	12,300	12,300
Cost per H.-P.	30.75	
Value of 500 H.-P. water		7,950
Value of 1 H.-P. water	15.90	

A summary of cost of steam-power and value of water-power at seven successive divisions, the required mill-power remaining at 900 horse-power, is given in Table VIII.

TABLE VIII.

Cost of Steam-power.			Value of Water-power.		
Amount.	Per H.-P. annual.	Total cost.	Amount.	Per H.-P. annual.	Total value.
1	2	3	4	5	6
200 H.-P.	$39.70	$7,940	700 H.-P.	$17.60	$12,310
300 "	34.07	10,220	600 "	16.72	10,030
400 "	30.75	12,300	500 "	15.90	7,950
500 "	28.61	14,305	400 "	14.86	5,945
600 "	27.50	16,500	300 "	12.50	3,750
700 "	26.27	18,390	200 "	9.30	1,860
800 "	24.10	19,320	100 "	9.30	930
900 "	22.50	20,250	0 "	....	....

In addition to the value of the diverted water-power, there is also a depreciated value to the remaining water-power. This is easily found by finding the value of the water-power before and after diversions, and the difference between the two, multiplied by the amount remaining, is the amount to be paid for depreciation. Table IX gives these amounts, as well as the direct damages for 100-horse power diverted at seven intervals.

TABLE IX.—Annual Cost of 100 H.-P. Diverted Successively, and Depreciation of Remaining Power for Seven Periods. Required Mill-power always 900 H.-P. Cost thereof at $22.50 = $20,250 per Annum.

Amount of water-power.	Value of water per H.-P.	Difference.	Cost of 100 H.-P.	Water-power remaining.	Amount of Depreciation.	Total Cols. 4 and 6.	Cumulative Amount.
1	2	3	4	5	6	7	8
700 H.-P.	$17.60	0.88	$1,760	600 H.-P.	$528	$2,288	$2 288
600 "	16.72	0.82	1,672	500 "	410	2,082	4,370
500 "	15.90	1.04	1,590	400 "	416	2,006	6,376
400 "	14.86	2.36	1,486	300 "	708	2,194	8,570
300 "	12.50	3.20	1,250	200 "	640	1,890	10,460
200 "	9.30	0.	930	100 "	....	930	11,390
100 "	9.30	....	930	....	....	930	12,320
Total....	....	....	$9,618	....	$2,702	$12,320	....

The accounts of the water-power owner will, therefore, stand as in Table X.

TABLE X.

Receives annually from the mill owner for 900 H.-P.	$20,250
Before any water is taken, expends annually for steam-power (Table VIII. Column 3)	7,940
Leaving a net income of	$12,310
1st—When 100 H.-P. are taken at $17.60 plus depreciation, receives from mill owner	$20,250
100 H.-P.—From city, (Table IX, Column 8)	22,288
A total income of	$22,538
Expends for steam-power (Table VIII, Column 3)	10,220
Net income	$12,318
2nd—Second diversion at $16.70 plus depreciation, receives from mill owner	$20,250
100 H.-P.—From city ($2.288 + $2,082)	4,370
A total income of	$24,620
Expends for steam (Table VIII, Column 3)	12,300
Net income of	$12,320
3rd—From mill owner	20,250
From city	6,376
100 H.-P.—Total income of	$26,626
Cost of steam as above	14,305
Net income	$12,321

It will be seen that the analysis proves itself correct in every instance. The water-power owner, whose income was $12.320 per annum before any diversion of water took place, always receives the same figure, whether much or little, or all be taken at intervals or all at one time.

It is sometimes admitted by engineers on the other side that my analysis for ascertaining the value of water-power may be correct, but that diverted water power must be paid for at what it costs to take its place. Thus the value of the water-power is $18.52, but the cost of its auxiliary steam-power is $35.60 per horse-power, and they would thus maintain that that should be the amount to be paid for diverted power. This seems very plausible, and it is a fallacy not easily seen through by engineers, attorneys or courts; but it is all a fallacy nevertheless. It is a fallacy in the first place, because if the theory were correct, it would lead to absurd conclusions. Thus, if the entire water-power of 690 horse-power were taken and paid for at the rate of the cost of its auxiliary steam-power, namely, $35.60, the damages would be $24.564, which exceeds the cost of an entire 900-horse-power steam plant.

It is fallacious, in the second place, because it makes the damages to an imperfect or insufficient water-power greater than is conceded to be the value of a perfect or complete one! that is, it is claimed that $35.60 per horse-power should be paid for a defective water-power when $22.50 per horse-power will pay for a perfect power.

It were perhaps better for a clearer understanding of this problem if the cost of furnishing the auxiliary steam-power were not reduced to its equivalent cost per horse-power at all, and simply to say that it costs the water-power owner so much money to supply the natural defects of his water-power, which expense he must to go in order to find a market for his water-power. The question of cost of steam-power is only entered into in order to ascertain the true value of the water-power, and it is the interest of the water-power owner to make it as little as possible. As a matter of fact, for the small diverted power, it costs him only the price of coal, say $14 per horse-power per annum, while he is paid, under this analysis, $18.52 per horse-power. It is held, however, that if he is paid only for the coal consumed, he is paid nothing for his plant, etc., and that the defendant has no right to use that plant.

The maintenance of this auxiliary steam plant is a necessity and a burden entirely upon the shoulders of the water.power owner, in order to make his water-power worth its maximum to himself, and that maximum value of water-power the defendant is willing to pay.

Two cases are at work which make this auxiliary steam-power disproportionately expensive: First, the natural fluctuation of the river flow; and second, its insufficiency for the uses of the mill. Neither of these causes are the fault of the defendant, except in the latter case, by the amount of diversion. It is not the fault of the defendant that the auxiliary power costs what it does, and he should therefore, not be made to pay for it. When he has paid the market or commercial value of the water-power plus the damage inflicted upon the balance of remaining power, he has met the requirements of equity.

Theorem 3 expresses the true basis upon which the damages should be paid. Under the analysis here laid down the water-power owner is not injured one dollar whether much or little water be taken, for he is assured precisely the same annual income he received before the city trespassed upon his rights as after. In the suit referred to, however, the amount of power diverted is so small compared with the river flow or total mill power that I neglected to compute this item.

A committee of the city council of Sherbrooke, Que., has been appointed to interview the Sherbrooke Water & Power Company relative to the purchase of their plant.

POWER PROJECT IN MEXICO.

Canadian capitalists have just organized the Mexican Light & Power Company, for the purpose of establishing an extensive electric plant about eighty miles from the city of Mexico. Those interested in the project include Messrs. B. F. Pearson, of Halifax, Hon. George A. Cox, William Mackenzie and E. R. Wood, of Toronto, and James Ross, of Montreal.

The company is incorporated under the laws of Canada and has an authorized capital stock of $12,000,000. It is understood that Mr. James Ross has the largest interest in the concern and that he and his associates will do about two-thirds of the underwriting. The construction of the plant will require about two years and the quantity of power generated will be about 40,000 h. p.

THE SHAWINIGAN TRANSMISSION PLANT.

On Saturday, February 7th, the Shawinigan Water & Power Company successfully started their power transmission plant between Shawinigan Falls and Montreal. The transmission line, which is of aluminum cable, is a fraction of over eighty-four miles in length. The transmission is at 50,000 volts 30 cycles. The line has a maximum capacity of 8,000 horse-power. The apparatus at present installed is capable of delivering 2,500 horse-power, and additional apparatus is being put in as rapidly as possible for 2,500 horse-power more. The step-up and step-down transformers and switchboard apparatus were furnished by the Westinghouse Electric & Manufacturing Company, and the synchronous frequency chargers for changing from 30 to 60 cycles by the Bullock Electric Company. This apparatus was all set up ready for operation seven months from the date of the order for it. The 50,000 volt line insulators were furnished by the R. Thomas & Sons Company, of East Liverpool. The aluminum cable was supplied by the Pittsburg Reduction Company.

The station buildings for the transmission were designed by Mr. Wallace C. Johnson, chief engineer of the Shawinigan Water & Power Company, who also had in charge the carrying out of the construction work. The transmission was laid out and the construction directed by Mr. Ralph D. Mershon, consulting engineer for the Shawinigan Company.

MIDLAND ELECTRIC LIGHT ARBITRATION.

The arbitrators appointed to value the plant of the Midland Electric Light Company have given their award. The town offered $8,000 for the plant, while the company asked $18,000. The valuation fixed by the award is $9,630. The result of this arbitration is most unsatisfactory to the owners of the plant, as it was believed that the award would not be less than $16,000. The circumstances of the case are of interest. Mr. James Playfair, the owner of the plant, was some years ago requested to install the plant to accommodate the Council, and after risking his money and bringing the plant to the point where it had become a paying investment, it now becomes the property of the Corporation at a valuation little above that of scrap. The case was argued and conducted by Mr. William Steers, a well-known barrister of Lindsay, who was ably assisted by an experienced expert. It is claimed that some of the evidence submitted on behalf of the Corporation was extremely contradictory.

The plant consists of a 200 k.w. T. H. alternator (new), one 35-light Wood arc dynamo, 19 street lamps, 16 private arc lamps, and some 2,000 lights in transformers, mostly C. G. E. and S. K. C., also two engines, boiler, pumps, etc. There is a large overhead construction besides. The business of the company is quite large, and as Mr. Playfair has been one of the moving spirits in building up the town of Midland, it was expected that more liberal treatment would have been received.

THE TORONTO-NIAGARA POWER COMPANY.

The Ontario Government has passed an order-in-council granting a franchise for the development of power at Niagara Falls to the Toronto-Niagara Power Company, at the head of which is Mr. Frederic Nicholls, general manager of the Canadian General Electric Company, Mr. William Mackenzie, president of the Toronto Street Railway Company, and Lieut.-Col. H. M. Pellatt. The terms of the agreement have not yet been made public.

The application for a franchise was opposed by the Canadian Niagara Power Company, but the Niagara Falls Park Commissioners recommended that the franchise be granted and the government agreed to the application. Mr. J. W. Langmiur, chairman of the Niagara Falls Park Commission, is quoted as saying that Niagara Falls is capable of producing over 5,000,000 h.p. of electrical energy, and that less than 4 per cent. is as yet harnessed.

The new company are now calling for tenders for the construction of a timber crib coffer dam in the Niagara river near Tempest Point, and evidently propose to carry to completion their proposed works at the earliest possible moment. Mr. Frederic Nicholls, of Toronto, is general manager of the company, and Mr. Hugh L. Cooper, of New York, chief engineer.

THE WINNIPEG GENERAL POWER COMPANY.

A company was recently organized in Winnipeg to be known as the Winnipeg General Power Company. The company propose to develop a waterfall on the Winnipeg river near Lac du Bonnet and to transmit electric power to Winnipeg, a distance of fifty-five miles. The preparatory work has already been commenced. The river will be dammed by a structure 400 feet long and 20 feet high, and it is intended that the initial development shall be 10,000 h. p. The site is said to be an ideal one for the generation of power, and no doubt a modern plant will be installed. The pole line will cross the municipalities of Brokenhead and Springfield in a direct line.

The company expect to supply power for operating the street railway system, the waterworks, the Ogilvie mills, and other establishments. Mr. J. F. Mackenzie, manager of the company, has opened an office in the Canada Life Block, Winnipeg. Mr. H. L. Cooper is chief engineer, with Messrs. Hirt and Brown as assistants.

Mr. A. F. Gerald, of Fairfield, Maine, has been looking over the ground at Charlottetown, P. E. I., with a view to building an electric railway.

THE TORONTO RAILWAY COMPANY.

At the annual meeting of the Toronto Railway Company, held on January 21st, a satisfactory statement of the year's business was presented. The gross earnings amounted to $1,834,908.37, as compared with $1,661,017.50 in the previous year. The net earnings were $819,547.05, as compared with $603,405.40. That the financial statement did not show a larger net revenue is accounted for mainly by the higher prices paid for material used in maintenance and repairs, by the abnormally high price of coal, a large increase in wages of employees, and a large outlay of money occasioned in the detection and punishment of systematic thieving.

A comparative statement shows that the gross earnings have grown steadily for the past ten years. Operating expenses and net earnings have likewise increased. The percentage of operating expenses to earnings was heavier last year than in any previous year with the exception of 1893. The figures for ten years are as follows: 1893, 59.07; 1894, 54.0; 1895, 49.3; 1896, 50.9; 1897, 48.8; 1898, 47.4; 1899, 48.8; 1900, 51.0; 1901, 51.6; 1902, 55.3. It will be seen that the operating expenses in proportion to earnings reached the lowest point in 1898.

New Office Building to be Erected by the Canadian General Electric Company at Corner of King and Simcoe Streets, Toronto.

The number of passengers carried for ten years is as follows: 1893, 21,215,010; 1894, 22,609,338; 1895, 23,353,228; 1896, 23,537,911; 1897, 25,271,314; 1898, 28,710,388; 1899, 31,826,940; 1900, 36,061,867; 1901, 39,848,087; 1902, 44,437,678.

The directors declared during the year four quarterly dividends of 1¼ per cent.

The old board of directors and officers were re-elected as follows: President, William Mackenzie; Vice-President, James Ross; Hon. Geo. E. Cox, Frederic Nicholls, W. D. Mathews, H. M. Pellatt, James Gunn; E. H. Keating, manager; J. C. Grace, secretary-treasurer.

THE OTTAWA ELECTRIC RAILWAY COMPANY.

The annual meeting of the Ottawa Electric Railway Company was held at the head office, Ottawa, on January 26th. The statement showed that during the calendar year of 1902 7,097,232 passengers were carried, which was a slight decrease as compared with the previous years, due largely to the cold, wet summer. Four quarterly dividends of two per cent. each were declared.

The following directors were elected: Messrs. T. Ahearn, G. P. Brophy, Peter Whelan, W. Y. Soper, Thomas Workman, Alexander Lumsden and Hon. George A. Cox. At a subsequent meeting of the directors, Mr. T. Ahearn was re-elected president, Mr. Peter Whelen vice-president, and Mr. James D. Fraser secretary-treasurer.

The annual meeting of the Sherbrooke Gas & Water Company was held at Sherbrooke, Que., on January 29th. It was stated that the new dam which was built last fall would provide 2,400 nominal horse power. After the election of directors, Mr. Justice White was re-elected president and Mr. F. P. Buck vice-president.

The annual report of Mr. Champagne, boiler inspector for Montreal, shows that more boilers were constructed last year than ever before in one year, also that no boiler explosions occurred. The following figures are given: Boilers condemned as unsafe, 19; boilers found imperfect, 119; boilers erected during the year, of which 26 were second-hand, 70; notice of inspection served, 209; certificates issued, 460.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, February 9th, 1903.

The Finance Committee of the City Council have, for the time being at any rate, rejected the request of the Fire Committee for an appropriation of some $5,500 for the establishment of an electric inspection bureau for the inspection of interior and exterior wiring. The subject, however, is by no means dead, although the published statement that the Fire Underwriters netted a clear profit of 20 per cent. on last year's business may keep it in a trance for a while, showing as it does that the amounts lost from genuine electrical fires cannot be so very large.

The Lachine Rapids Company were assisting the Montreal Light, Heat & Power Company during the repairs to the latter's dam at Chambly, it is said to the extent of 3,500 h. p., but lately owing to price quibbles this quantity has been materially cut down. Just what is the real inwardness of the controversy in regard to power supply is one of those things no one can find out. The Royal Company claim excessive price it is said, whereas the other story is that the Lachine Company billed them at the same rates as they were charged by the Royal Company for similar service when afflicted with ice troubles a couple of years ago.

Mr. Warren, the representative of the Canadian General Electric Company, formerly with the Montreal staff, left at the beginning of the year to take up a position at the Toronto headquarters. Mr. Warren was hail fellow well met and esteemed by all his confreres, who will miss him at the old place.

A fire (the second one) which occurred lately at the Mount Royal Club, one of Montreal's most exclusive and elaborate clubs, has been chronicled in the press as being of electrical origin. Like many others, after rigid examination, there is not one iota of proof. The fire appeared to have been caused by one of the workmen engaged in the alterations to the building, being careless while smoking.

In case some one may feel that the NEWS is biased in contradicting so many alleged electrical fires in Montreal lately, your correspondent wishes to say that he knows whereof he speaks and would only be too pleased to have some light thrown by "the other side" on the points at issue.

Surely the Montreal Street Railway can improve on the fight with snow as attempted on or about the 23rd of January. The fall was by no means as heavy as that on the famous "Ladysmith" day, which was attacked with much more spirit. Mr. Wanklyn, the manager, states that there was no lack of power; it is therefore assumed that there must be a lack of sweepers or something else. As to the use of salt, if not used too promiscuously, there are sufficient votes controlled by the public who use the street railway to oust any alderman who panders to the hackmen's union on that head.

In these days of numerous railway collisions, it would be interesting to know just why the numerous patent electric alarms devised for just such purpose have never been made use of? Are they all bad? These remarks do not appertain to the block signal systems, but to alarm bells, etc., in the cab actuated automatically by a second train being in proximity to a first either following or approaching. The United States patent records show grants for many of such.

The Shawinigan Company have all their poles erected and are busy stringing the necessary illuminum wire to supply current to the Lachine Company, who will distribute 1,000 H.P. of same in Montreal. The transmission is over 60 miles and the voltage, it is said, will be 55,000.

The first annual dinner of the Electrical Contractors' Association was held at the "Oxford" on the evening of the 14th ultimo. The event passed off most successfully. Guests from the electrical supply dealers and power companies were present. Mr. D. S. Barton replied to the toast of the Lachine Company, while Mr. J. A. Douglas spoke for the Montreal Light, Heat & Power Company. The electrical supply dealers were ably represented by Mr. C. Doutre, who replied on their behalf, as did also Mr. J. A. Dawson. Mr. G. S. Sheppard, representing the Builders' Exchange, also said a few words in regard to an important movement on hand, soliciting the co-operation of the electrical fraternity. The President, Mr. W. B. Shaw, then introduced the new president for 1903, Mr. W. H. Scott, of J. E. Scott & Company, who on taking the chair explained some of the objects of the Electrical Contractors' Association, which subject was further elaborated upon by Mr. G. S. Hill, the Secretary. Some songs were then contributed, and after further enjoyment the proceedings were closed by singing "God Save the King."

SUBURBAN ELECTRIC RAILWAYS.

Considerable activity is at present being manifested in different sections regarding the reaching out of existing street railways for suburban traffic. The Hamilton-Ancaster route is still in embryo, with several projected routes. The Galt line is being completed to Puslinch lake and the Guelph line is being brought down to meet it at the lake. The line from Preston to Berlin will shortly be running. The Berlin-Waterloo line is now running to Bridgeport with hourly service. There is a 20-minute service between Berlin and Waterloo.

Preston seems destined to be the hub of electricity for a district fifty miles around. They have already connections with Hespeler, Galt and Berlin, with prospects of getting to Guelph in the near future. The Galt, Preston & Hespeler Railway, of which Mr. P. J. Clemens is manager, and Mr. Ed. Haller the assistant electrician, expect to take power from the Cataract Power Company at DeCew Falls or from Niagara Falls, as the power generated at their power house at Preston is limited. They have two heavy freight motors now running. In the power house is one General Electric generator, 650 revolutions, 550 volts, 150 h.p., 60 cycle, and one Westinghouse generator, speed 750, 550 volts, 100 h.p.; two tandem compound Wheelock engines, made by Goldie & McCulloch, 150 h.p. each; one Northey feed pump, three Goldie & McCulloch boilers, 80, 100 and 80 h. p. They run a service hourly from each end in winter and half-hourly in the summer months. Saturday afternoons and holidays the service is doubled.

SPARKS.

The London Engine Supplies Company, Limited, of London, Ont., has been incorporated, with a capital of $40,000. The provisional directors are Messrs. F. G. Mitchell, A. M. Smart and John Jones.

The British Columbia Electric Railway Company are testing a new car fender, the invention of Mr. F. Young. It is made of stout rubber strips, stretched on an iron frame, and is so constructed as to enable the motorman to either raise or lower it by a lever inside the car.

Mr. H. M. Rumball, of London, Eng., has undertaken to finance the South-Western Traction Company. This company proposes to build electric roads from Hamilton to Glencoe, Brantford, Woodstock, Ingersoll and London. Dr. McKay, of Ingersoll, is a director of the company.

The Renfrew Electric Company, of Renfrew, Ont., have declared a semi-annual dividend for the latter half of 1902 at the rate of 6 per cent. per annum. Officers have been re-elected as follows: President, Mr. A. A. Wright, M. P; vice-president, Mr. A. H. Hough; secretary, Mr. I. H. Wright.

The Canadian General Electric Company have had plans prepared for a magnificent building to be erected on the old Upper Canada College Grounds, King St. west, Toronto. Although no official announcement has been made, it is understood that the building will be used largely for warehouse and show-room purposes.

The arbitrators have fixed the price to be paid by the town of Gravenhurst, Ont., for the electric light plant owned by Mr. R. Fielding at $18,012. The award also places the cost of the arbitration on the town, which will make a grand total of $22,000 to be paid for the plant. The council have decided to take over the plant in accordance with the award.

The rate war has apparently been commenced by the electric companes in Ottawa. The Ottawa Electric Company some time ago reduced its rates to the scale adopted by the Consumers' Company. The latter company then made a further reduction, the rate on February 1st to be 12 cents per 1000 watt hours, with a discount of 33⅓ per cent. for payment within 15 days after the account is presented. This is equivelent to a net rate of 8 cents per 1000 watt hours.

TRADE NOTES.

The William Kennedy & Sons Company, of Owen Sound, Ont., have just shipped six turbines to the Lachine Rapids Hydraulic & Land Company, Montreal.

Messrs. D. McKenzie & Company, 298 Richmond street, London, Ont., have issued a catalogue describing the "Eclipse" gas and gasoline engines manufactured by them.

Messrs. Veritys, Limited, London, England, have sent us a copy of their price list, No. 50, referring to the Aston Patent Electric Radiators and Radiant Heat Warming Stoves for use in house warming.

The calendars received from the Christensen Engineering Co., manufacturers of air brakes and "Teco" electrical machinery, Milwaukee, Wis., are works of art, and are certain to command attention and respect for this enterprising firm.

The Robb Engineering Company, of Amherst, N.S., have received an order from the Nova Scotia Steel Company for two vertical engines of 600 h. p. to be used for electric lighting purposes at Sydney Mines. The engines will be fitted with the new Armstrong-Corliss valve gear.

With the completion of the two wings just erected and now occupied, the Northern Electrical Mfg. Co., Madison, Wis., U.S.A., is prepared to handle the natural increase in its business, although the new quarters are already crowded. The wings are 38' x 100' 4" and 37' 8" x 100' 4" respectively, of solid brick construction.

The late Spanish-American war seems to have impressed upon the engineers of the Spanish Government the need of adopting the most modern methods in the manufacture of munitions of war. They are installing Westinghouse motors in their gun shops at Trubia, and the Spanish arsenal at Ferrol is also shortly to be equipped with a number of motors and other electrical machinery.

Most of the readers of the ELECTRICAL NEWS have to do with the purchase and operating of machinery, and should therefore be interested in learning something about the fibre pulleys manufactured by the Xylotite Manufacturing Co., of Cincinnati. In their full page advertisement in this number the company show an illustration from a photograph of one of their pulleys 52½' x 56' x 8". Full particulars regarding these pulleys may be had by addressing the company and referring to their advertisement in this paper.

An elaborate calendar has been received from the Underfeed Stoker Company, Limited, of Toronto, the feature of which is splendid half-tone illustrations of the following public buildings in Canada in which "Jones" underfeed stokers have been installed: Foresters' Temple, King Edward Hotel and City Hall in Toronto; Grand Trunk Railway Building, Windsor Hotel, Place Vigar Station, Merchants' Bank Building, and Royal Victoria Hospital in Montreal; Kingston Penitentiary; Russel House, Ottawa, and Asylum at Orillia.

The New York Edison Company has recently placed a contract with Westinghouse, Church, Kerr & Company for another 6,500 h.p. Westinghouse vertical three cylinder compound engine of the same size and construction as the eight already in operation and being installed at their 39th Street Water Side Station. This contract includes an independent stream driven air and circulating pump condenser equipment and is the third order received from the New York Edison Company for these engines, the first covering eight units, the second two, and the third one, a total of eleven units, aggregating 71,000-H.P. normal, or 100,000-H.P. maximum capacity. The engines are direct connected to 4,000 K.W. revolving field generators, supplying high tension polyphase current to the various local sub-stations throughout Manhattan.

In the electrical world new inventions and creations are a matter of daily occurrence and many of these therefore pass with comparatively little notice. However, since the problem of electrical power transmission has become such an important factor, it is interesting to record the invention of "Type R," the new transformer which the Packard Electric Company, Limited, of St. Catharines, Ont., is now putting on the market. "Type R" is constructed along lines which makes the transformer much more compact and of much lighter weight while at the same time space for ventilation has been greatly increased by a novel adaption of the coils. "Type R" is so designed that much greater life is given to the coils and the insulation is made practically indestructible. In this way a higher electrical efficiency and closer regulation is attained. In placing "Type R" on the market the Packard Electric Company has this to say concerning its advantages: "In its actual performance "Type R" excels the claims made for any other transformer. We claim for it, first, a low difference of potential between layers and consequent greater safety; second, an almost indestructible insulation between the individual coils and between the coils and iron; third, the lowest temperature rise and maximum of radiation surface; fourth, the lowest core loss and the use of iron which will not show appreciable aging; fifth, small impedance and little magnetic leakage; sixth, a higher efficiency than any other regular line of transformers; seventh, the closest regulation. Backed by the Packard Electric Company these claims of excellence give "Type R" a right to the careful consideration of all transformer users. A preliminary bulletin descriptive of "Type R" will be sent on application to the Packard Electric Company, St. Catharines, Ont.

The ratepayers of Regina, N. W. T., are taking steps to install waterworks and sewerage systems and an electric light plant. It is estimated that the latter will cost $20,000.

SPARKS.

It is reported that a company is being formed in Smith's Falls, Ont., to manufacture electric transformers.

The Ottawa Street Railway Company have written to the city council offering to undertake a number of extensions to the system.

The Dominion Government is asking for tenders for the supply of shafting, etc., required for the transmission of power at the Artillery Workshops, Quebec.

The third electric street railway established in the Dominion was built in Yarmouth, N. S., in 1892. The enterprise was not a financial success, and the company has given official notice of the proposed discontinuance of the service.

The annual general meeting of the Shawinigan Water & Power Company was held in Montreal last month. Mr. R. W. Douglas, secretary of the company, was elected on the board of directors in lieu of Mr. William Farwell, of Sherbrooke. The directors left Montreal to make an inspection of the transmission line between that city and Shiwinigan.

THE PIONEER
Independent Telephone Factory of America
is owned and controlled by the
Western Telephone Mfg. Co.

This factory has supplied more Public Exchanges with Telephones and Switchboards than any other.
We can furnish anything needed in the Telephone Line; and sell apparatus outright
Direct from Factory to Consumer.
Our new Central Energy and Lamp Signal Systems are "up-to-date" and ahead of competitors.

Western Telephone Manufacturing Company
Offices: CHICAGO, ILL., U.S.A. Factories: WINTHROP HARBOR, ILL., U.S.A.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

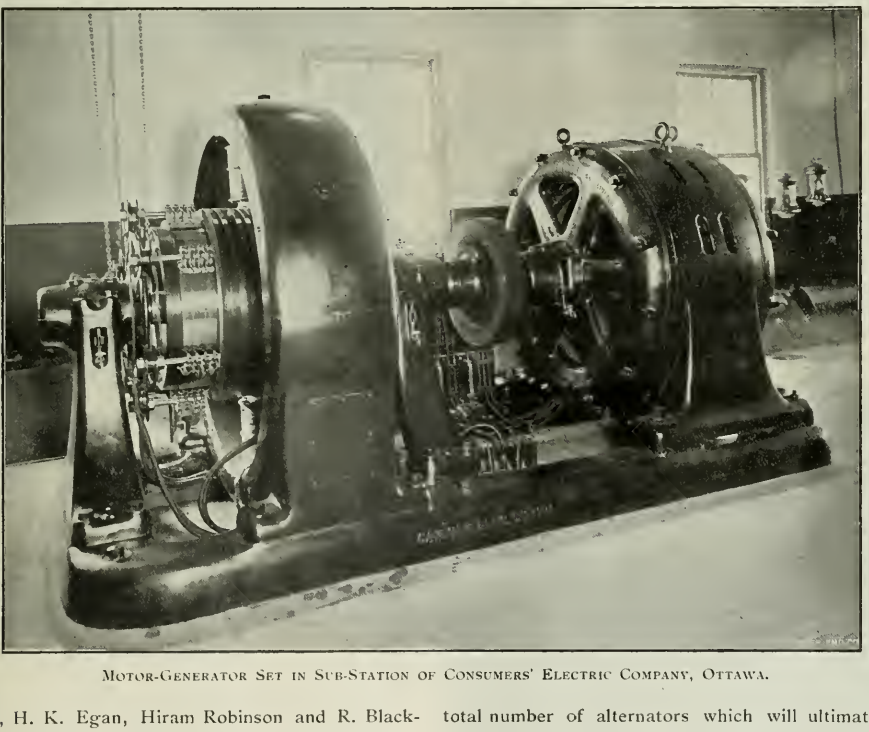
Vol. XIII. MARCH, 1903 No 3.

INSTALLATION OF THE OTTAWA AND HULL POWER AND MANUFACTURING COMPANY.

In the spring of 1901 a Dominion charter was granted to the Ottawa and Hull Power & Manufacturing Company to develop power at a certain point on the Ottawa river at Chaudiere Falls. The promoters of the company included Messrs. W. C. Edwards, M.P., Alex. Fraser, H. K. Egan, Hiram Robinson and R. Blackburn. Work in connection with the development was commenced in the summer of the same year and has recently been carried to completion. The power house is a substantial structure, of fireproof construction, practically all steel and concrete. While the plant does not embody many features which differ materially from standard engineering practice of to-day, careful attention has been given to its equipment and arrangement with a view to economical operation.

The Ottawa and Hull Power Company is solely a producing corporation, and from this fact is somewhat unique. The total power generated is transmitted to a sub-station of the Consumers' Electric Company, by whom it is distributed to customers.

There are at present installed in the power house two 1,500 k.w., 60 cycle, 2,300 volt, two-phase revolving field generators, direct connected to water wheels running at 138 r.p.m., and two 112 k.w., 125 volt, compound wound, direct current generators to be used as exciters. These latter are sufficient for exciting the total number of alternators which will ultimately be installed, namely, five. They are direct connected to wheels running at 320 r.p.m. Details of the turbine installation are given further on.



Motor-Generator Set in Sub-Station of Consumers' Electric Company, Ottawa.

All the electrical apparatus was supplied by the Canadian General Electric Company. The generators, one of which is shown on the following page, are guaranteed to carry a 50 per cent. overload for two hours.

The switchboard, rear views of which are shown, consists of the usual arrangement of generator, exciter and feeder panels, equipped with automatic switches, wattmeters, ammeters, etc. The field rheostats are located below the main gallery, as are also part of the switches, current transformers, etc. This arrangement provides ample room to handle all parts with freedom and effectually prevents any possibility of an arc should one be accidentally established in one part of the board communicating to any of the adjacent equipment. There are two sets of busbars so arranged with suitable switches that any circuit can be thrown onto one set or the other. The generators can be similarly connected, which allows the light and power circuits to be kept entirely separate if such is desired.

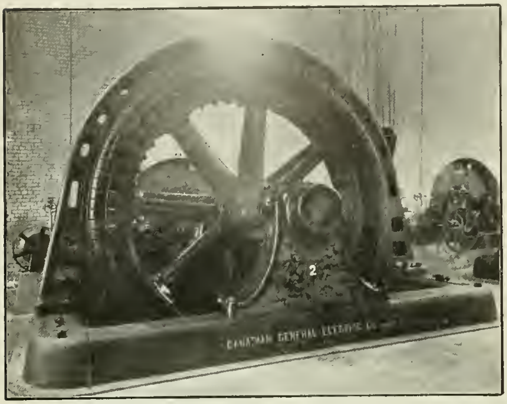


Fig. 2.—One of the 1500 k. w. Alternators in Power House of Ottawa & Hull Power Company.

As stated above, the current is transmitted at 2,300 volts to a station of the Consumers' Electric Company, the installation in which consists of a 200 horse power motor generator set, composed of a 200 h.p. 2,000 volt induction motor direct connected to a 150 k. w. 500 volt direct current generator, as shown in Fig. 1. This set supplies power to various motors throughout the city. There is also a constant current transformer for controlling an alternating current series arc light circuit which illuminates the beautiful drive of the Ottawa Improvement Commission. All of the foregoing machinery was manufactured and installed by the Canadian General Electric Company. The switchboard which controls the alternating lighting and power circuits was furnished by the R. E. T. Rringle Company, of Montreal. All the wiring is done in lead covered cables, which are laid in ducts and tunnels underneath the floor, and thence out through the wire tower to the overhead lines. This makes an extremely safe and neat arrangement, the appearance of the whole building, both inside and out, being very pleasing. In addition to the dynamo room proper, the station also contains offices, store and testing rooms.

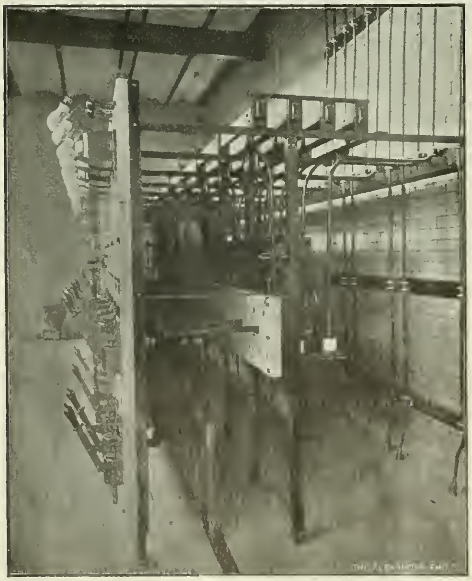


Fig. 3.—Switchboard on Gallery, with Upper Set of Switches and Busbars.

Reverting to the turbine installation in the power house of the Ottawa and Hull Power Company, the average head is 27 feet. The turbines for each generating unit are four in number, connected tandem, and were built by the Dayton Globe Iron Works Company, of Dayton, Ohio, being their latest improved cylinder, gate draw-rod type. They are mounted on two cast-iron draft chests, with draft tubes 9 feet in diameter (Fig. 5). The wheels proper are of the New American type, made in one continuous casting, 51 inches in diameter, and when tested at the Holyoke testing flume gave an efficiency of 86.71 per cent. at full gate. This wheel is one of the most efficient ever tested in the Holyoke flume. The shafts are made of steel and were forged by the Bethelem Steel Company. They are in two pieces each, with intermediate coupling flanges forged on. They are 5 7/16 inches in diameter at the remote ends, increasing in size to 10½ inches in diametor at the driving ends. The gate is of the well-known cylinder draw rod type and has several features not usually found in this class of gate.

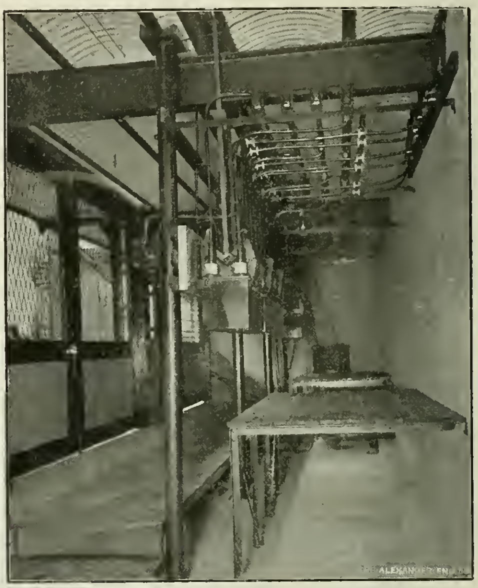


Fig. 4. — Lower Set of Busbars and Switches on Main Floor Immediately Below Fig. 3.

The gate proper slides on ways similar to those on a steam engine. On these ways or guides are adjustable gibs, which can be operated by bronze set-screws, thus taking up the wear and keeping the gate from touching or rubbing the inlet chutes on the bottom. The gate rods are fastened to the gates in the center of these guides or ways, bringing the line of force and that of resistance on the same plane, thus obviating the tendency to tip and bind which is most objectionable in ordinary cylinder gates when operating horizontally. This method of operating gates has proved so successful that the manufacturers have patented it.

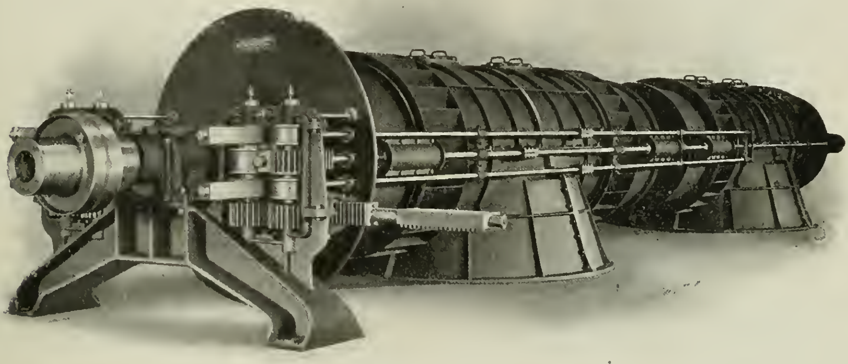


Fig. 5.—Tandem Connected Turbines.

Another feature of this device is, that all gearing races, etc., are outside of the flume, away from the water, and accessible at all times. This entire mechanism is mounted on the main bridge-tree, as shown in Fig. 5. It consists of two vertical shafts on each side of the bridge-tree, on which are placed cut pinions to move the cut racks on the gate rods, the rods passing through the stuffing boxes in the flume head. In order to bring the line of action in the centre of the gate bearings, three draw-rods are used. The upper and lower rods act in conjunction with one another and move the gate of the second and fourth wheels through yokes and hollow tubes. The gate rod on the wheel, No. 2, is a hollow brass tube so as to allow the centre gate-rod which operates the gates on wheels No. 1 and 3 to pass through for a connection to gate No. 3. The two lower pinions on the vertical shafts on the bridge-tree are connected to the transverse or operating rack by an intermediate gear (not visible in the cut), thus causing all the gate rods on both sides of the wheels to move in unison. The governor and hand-operating device is connected to the transverse racks by a pinion working into the racks shown on the end.

The gears and racks are supported by a cast-iron frame of the bridge-tree and are also stayed to the flume head by large stay bolts, thus giving the entire structure great rigidity and maintaining a compact design, the principal elements of which have been patented. All the bearings in the water are of lignum vitae and are adjustable by bronze set-screws for taking up the wear. The thrust is taken care of by lignum vitae thrust bearings on the rear end of the shaft. The governors are of the Woodward compensating type and were built especially for this installation. The turbines for the exciter units are of the cylinder draw-rod type similar to the generating units. There are two sets of two wheels each of the New American type, 22 inches in diameter, mounted on sheet steel draft chests, the whole mounted on steel I-beam foundations, built in the concrete. The gate operating mechanism is the same in principle as that of the large units, but not so complicated, as there are only two wheels in each unit to control. The governors on these units are the Woodward compensating type.

Fig. 6 is a rear view of the exciter unit showing the connecting yoke for the gate-rods. This view also shows the position of all the gate-rods on the centre plane of the shaft.

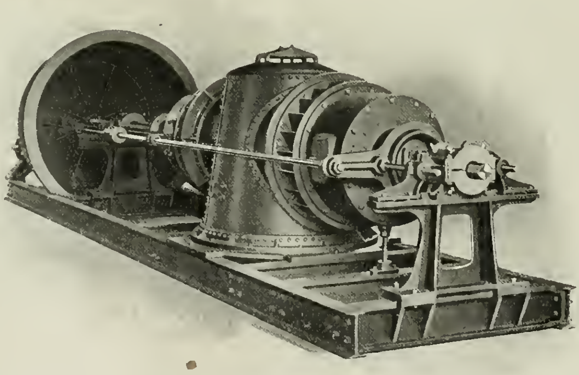


Fig. 6.—Exciter Turbine.

This installation was made under the supervision of Mr. Wm. Kennedy, Jr., hydraulic and mechanical engineer, of Montreal, Que.

Mr. Gordon Logan, chief accountant for the West Kootenay Power & Light Company, of Rossland, B.C., recently spent a short time in the east on business.

THE CANADIAN GENERAL ELECTRIC COMPANY.

The statement presented at the recent annual meeting of the Canadian General Electric Company, held at the head office in Toronto, was of a very satisfactory character. It showed that the profits for the year 1902 were $436,863.10, out of which two half-yearly dividends amounting to $213,739.22 were paid. Of the balance $120,081.78 was written off for depreciation, $100,000 transferred to reserve, and $3,042.10 added to credit of profit and loss account, which now stands at $80,722.37. Balance at credit of profit and loss December 31, 1901, was $612,028.94. To the $100,000 carried to the reserve fund from manufacturing profits the sum of $322,000, being premium of new share capital, has been added, making a total addition to the reserve fund for the year of $422,000. The reserve fund is now $787,000, plus $100,000 at contingent account, and $87,722.37 balance at credit of profit and loss, making the total surplus $967,722.37. As the company's permanent investment in the Canada Foundry Company's plant is $858,322, it will be seen, adds the report, that the surplus is more than sufficient to entirely cover the cost of this asset.

Although dividends have been paid on the new capital stock issued last year, this new capital has not hitherto been productive, as it has been invested in the Canada Foundry Company's business, which has already reached large proportions, but upon which no profit has been taken into account, although a small profit has been earned. In order to provide manufacturing facilities commensurate with the growth of the company's business, the directors have decided to again provide for extensive additions to the company's plant and equipment, and plans are being prepared for this purpose. An agreement has been entered into for the purchase of the Northey Manufacturing Company, of Toronto, manufacturers of steam pumps and hydraulic machinery.

During the year the company has also acquired the Canadian patents of the Curtis steam turbine for both land and marine uses. The steam turbine will probably revolutionize present methods of producing steam power, and many advantages are expected from this acquisition. The United States patents for this invention have been purchased by the General Electric Company, of Schenectady, N.Y.

Arrangements are being made with the Canadian Shipbuilding Company, whose works are to be located on the Niagara River, near the International Bridge at Fort Erie, which will provide for the manufacture by the Canada Foundry Company of the marine engines, boilers, and other machinery required by the shipbuilding company.

The Brantford Street Railway, which was previously owned and operated by the company, has been sold, the company taking in payment therefore first mortgage bonds on the property for $120,000.

The Canadian General Electric Company have had plans prepared for several new buildings to be added to their extensive works at Peterboro, Ont. One building will be 450 x 80 feet, to be used as a stores and shipping depot; another will be a manufacturing building 235 x 80 feet, and a third will be an addition to the new building erected last year. The buildings will be of brick and steel construction.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, March 11th, 1903.

We have the professional labor agitator from Toronto with us once again. This can hardly be a case of Toronto's loss being Montreal's gain!

How long is the electrical trade to be yet annoyed by 52 volt secondary service in Montreal? Surely it is time the small remaining residue of such customers were changed (like many) to 104. Then with both competing companies with a voltage and frequency practical similar, there would be some confidence in selling fans, heating devices and the like.

Claim is made that Prof. Rutherford, of McGill College, was the real inventor of the "magnetic detector" used by Marconi in place of the "coherer" in trans-Atlantic wireless telegraphy, the reason of this preference being given—that the detector is more sensitive than the coherer. Prof. Rutherford is a man amongst many who unfortunately do not imitate his broadmindedness. He does not believe in patenting any device that is likely to be of benefit to the public as a whole. Would that there were more inventors of the same stamp.

The Nernst lamp is making its appearance by degrees in Montreal, the single glower 110 volt type being by far in the majority over other types; this probably owing to lack of 220 v. a. c. current supply. The 220 lamps show up well and so do the 110, except that the glowers for the 110 seem to be a "bit more tender" than those for 220.

McGill University have entered their protest against Marconi being allowed to operate a wireless station from the summit of Mount Royal. The "kick," however, simmers down to one of a rather selfish nature. It is made under two heads: First, that such will interfere with their laboratory instruments; second, that Marconi currents will be conducive to electrical fires in Montreal. The first goes without question, but what of it? McGill will have to devise means to shield their instruments.

In Montreal Street Railway vs. Bell Telephone Company, it was decided that the use of the earth was common property, and it remained for the Bell Company to devise means to properly work its instruments. Surely the air is no less common property. The second point drew a number of insurance men up to McGill laboratories to see just how such fires could occur. The deductions, however, were of such a purely theoretical nature as to prove nothing of practical value to any electrical engineer. The only point of real value, and that was overlooked, was the desirability of having such on a public park? Would it not cause requests from factories also for permission to build on that site?

The late strike of the Montreal Street Railway employees was one of the silliest that has occurred. First, although the talk of a strike occurring and definite hour for same was public property for three days previous, yet when it did occur the management expressed surprise and were caught in a blissful state of unpreparedness. Second, from the striker's end the strike was totally unnecessary and there was not a single item conceded that would not have been secured through a signed petition or "round robin." The only good (if it can be called) brought forth by the strike was the opportunity given to some of our aldermen to show, by word of mouth, their David & Jonathan-like love for the working man (pro-tempo!) The thanks to the public printed from speeches of the strike leaders, "for walking out of sympathy," was rather rich and calls for no comment. The public was annoyed and inconvenienced, which they had no right to be, and it is hoped that the strikers and the management will settle their own affairs together and in private, should such a case occur again. Certain it is, that emboldened by the success of the Montreal Street Railway employees, others may try similar tactics in the spring; whether with success or no remains to be seen.

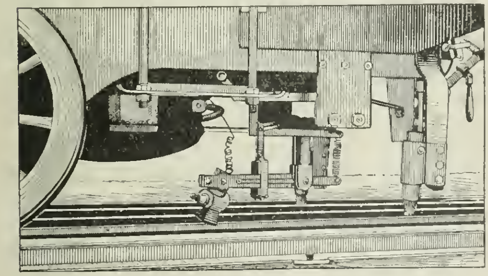
The Ontario Lantern Company, of Hamilton, manufacturers of the "Radiant Shelby" lamps for Canada, have recently decided to manufacture the Edison lamp also, which will be called the new "Brilliant." The company are now producing 1,500 incandescent lamps daily.

ELECTRIC SAFETY DEVICE FOR RAILWAYS.

A new electrical device for preventing collision between railway trains has recently been tested with some success on one of the state lines near Frankfort, Germany. Mr. Frank H. Mason, United States Consul-General at Berlin, has furnished the Government with a brief account of this advice, which seems to mark an important advance step in the solution of a difficult and perplexing problem.

The device is the joint invention of Messrs. Hubert Pfirmann and Max Wendorf, and its construction and method of operation are as follows: Midway between the rails is laid a light third rail ot the ordinary T pattern, the joints of which are so connected as to form a continuous conductor. Midway under the forward part ot the engine is hung the working instrument, an electrical apparatus inclosed in a square case or jacket occupying a cubic foot of space. The instrument is connected with a contact shoe (see illustrations), which slides along the third rail and by wires with a telephone and electric alarm bell in the cab of the engine driver, and a red incandescent lamp which is lighted by the same impulse that rouses the alarm bell into action. A further improvement of the device sets the electric brakes on the engine or entire train simultaneously with the alarm signal which sounds the bell.

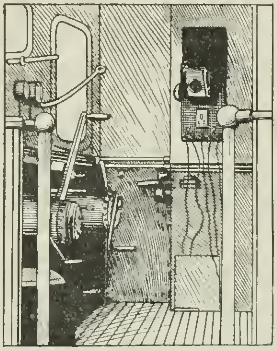
The tests were conducted on the main line from Frankfort to Hanau, between the stations Sachsenhausen and Goldstein, and a translation of the official report will illustrate concisely the working of the apparatus. Two locomotives, numbered respectively 290 and 1420, had been equipped with the new device and the experiments proceeded as follows: Engine 290, drawing a special train and approaching Sachsenhausen at full speed, received the danger signal and came to a full stop; the driver of 290 then asked by telephone the cause of the signal and received from the keeper of a grade crossing, half a mile in front, word that a wagon had broken down in crossing the track and obstructed the line. After ten minutes' wait, the engineer of 290 received word by telephone that the obstruction had been cleared away and thereupon resumed his trip.



Safety Denice for Railways.—Third Rail and Contact Shoe.

A mile farther on, the signal on 290 again sounded, and the driver was informed, by telephone as before, that the semaphore round a curve and more than half a mile distant was set at "halt". Thereupon engine 290 slowed down and proceeded cautiously, sounding its whistle at short intervals, the telephone bell in the drivers' cab ringing continuously until the curve was rounded, when the ringing ceased, notifying the engineer that the semaphore had changed to "track clear." Thereupon 290 resumed full speed.

In the tests to prevent collision, engine 1420 came up rapidly from behind and on the same track as 290, which had slowed down and was proceeding cautiously in consequence of reported danger in front. The moment that 1420 came within 1,000 meters (1,093 yards) of 290, the signal on both engines began to ring and their red lights to glow. Thereupon 1420 halted, the driver inquired of 290 in front the cause of the alarm, and a complete understanding between the two trains was immediately established. An important point in this connection is that in practice the same warning signal is sounded upon every engine equipped with the apparatus which is on the same track and within the prescribed radius—a kilometer or a mile, as the case may be—from the engine and train which cause the obstruction. If a semaphore be falsely set at safety, the train may run past it into a block in which another engine is halted or moving with perfect security that warning will be given in ample time to prevent a collision under any and all conditions of darkness, fog, storm, or mistaken instructions.



Safety Device for Railways.—Telephone, Alarm Bell and Red Light in Engine Cab.

The German Government has directed that a section of track be equipped with the apparatus for careful, practical experiments, and it is reported that the Government of Russia has obtained license to test it in actual service on its new military lines now under construction in Siberia.

CANADIAN ELECTRICAL ASSOCIATION.

The Executive Committee of this Associatio metn in Toronto on February 13th to make preliminary arrangements for the annual convention, which this year will be held in Toronto. Wednesday, Thursday and Friday, June 10th, 11th and 12th, were chosen as the dates for the convention. The local committee consists of all members of the Association residing in Toronto, with Mr. J. J. Wright as convenor.

Messrs. P. G. Gossler, of Montreal, A. A. Dion, of Ottawa, and J. J. Wright, Toronto, were appointed a committee to award prizes for papers of superior merit.

It is expected that the coming convention will be largely attended, especially by the western members, and that the programme will combine in a profitable degree instruction and pleasure.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY
THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.

1ST VICE-PRESIDENT:
EDWARD SLADE, General Superintendent Jacques Cartier Light & Power Co., Quebec.

2ND VICE-PRESIDENT:
B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A. B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
ORMOND HIGMAN, Chief of Electrical Inspection Department, Ottawa.
ED. A. EVANS, Manager Quebec Railway, Light & Power Co., Quebec, Que
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
A. SANGSTER, Manager Electric Light & Power Co., Sherbrooke, Que.
A. A. WRIGHT, M. P., President Electric Light & Power Co., Renfrew, Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON,	Toronto.
Vice-President, CHAS. MOSELEY,	Toronto.
Treasurer, A. M. WICKENS,	Toronto.
Registrar, J. G. BAIN,	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN,	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER	Baden, Ont.
Vice-President, H. E. TERRY,	Toronto, Ont.
Secretary, W. INGLIS,	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont.
Conductor, J. STRUTHERS,	Sarnia, Ont.
Door Keeper N. BEAN,	Waterloo, Ont

Grounding of Secondary Wires. The numerous fatalities from electric shocks which have occurred at various recent dates, and in locations so close as to bring the matter home to us with peculiar reality, lend increased importance to the already live point of grounding secondary wiring. The large majority of lighting work is now performed from alternating current circuits, which means that the streets are covered by a network of lines carrying a potential of not less than 1,000 volts, more likely twice this. In addition to this there are arc light lines and those of the telephone and telegraph companies, to say nothing of the overhead trolley, the whole forming a combination calculated to make one feel that crosses between the secondary and other lines carrying potentials which may or may not be dangerous, are more likely to be the rule than the exception. Further, there is the possibility of connection being made in the transformer itself, though this is rather remote, the quantity and quality of the insulation used in modern apparatus, as evidenced by records extending over a considerable period, making breakdowns of this character almost unheard of. On the other hand, it is almost impossible to guard against crosses being made outside the transformer, because storms, falling trees and broken wires may produce contacts at the most unlikely and inaccessible places. In view of this fact, that one cannot surely prevent abnormal voltages from some time or other getting onto the secondary lines, is it not desirable to absolutely prevent their power of harming the users of the service by wiring it solidly and firmly to a good ground? This may render imperative the use of better construction than is sometimes put into interior wiring, but it also means absolute immunity for those handling it, which is admittedly an end much to be desired.

A New Transmission. The past month has seen the starting of one of the notable transmission plants of Canada, namely, the Shawinigan system, which, as our readers are aware, has sold its output for the city of Montreal to the Lachine Rapids Company. The line is the longest which is operating in this country, namely, 80 miles, there being at present but one other projected installation, that from Niagara to Toronto, which will transmit over a greater distance than this. In addition to being the longest it will also enjoy the distinction of carrying the highest line potential, 50,000 volts, now in use in this country. In this respect also it is probable that for some time to come the Toronto-Niagara line will be the only one whose voltage will be carried to as high a point as this; possibly it may be run slightly above it. Another point in which the system is unique, at any rate on this side of the line, is that the line wire is aluminum, which is but natural in view of the close business interests between the power company and that which manufactures this material. There is but comparatively little data available, as the result of experience, regarding the behavior of this metal under the extremely low temperatures which prevail during parts of the year throughout the region in which the company operates, and the results obtained will be watched with great interest by electrical interests the Continent over. Previous to their contracting for this power the Lachine Company were carrying load up to the full maximum capacity of their apparatus, so that the addition to their plant puts them in a position to now care for much more business. In this connection it is perhaps to be expected that rumours regarding rate cutting in the effort to obtain new business will be rife, but it is to be hoped that this will not come to pass. A rate war is always bad in the long run for the principals concerned, besides having very injurious effects on the business in other cities, in which the impression is very likely to get abroad, even though it may be quite unjustified, that the companies operating in these localities are asking too much for their product, and that a wholesale reduction in their prices is justifiable and to be expected by the public.

Wireless Telegraphy

The subject of wireless telegraphy is receiving a great deal of attention just now in both the technical and non-technical press. The latest aspirant to recognition is the DeForest system, the promoters of which have been giving demonstrations during the latter end of February between Hamilton and Toronto. According to the newspaper reports experiments more or less successful have been conducted at various points in the States, and at the present moment plans are practically completed for the establishment of various stations on the California coast, in view of which the object of the local demonstrations does not immediately appear. The principle at the sending end does not seem to differ very materially from that of the other systems which are being exploited, the usual high voltage transformer with condenser, spark gap, and tower being used. At the receiving end the main part of the equipment consists of an anti-coherer, so called because its operation is the reverse of the receiving device, the coherer, in other systems. This latter instrument, normally of high resistance, becomes a good conductor when subjected to the influence of a discharge and when in this condition allows the passing of a secondary or relay current which in turn gives a signal readable by the operator. On the other hand, the anti-coherer of DeForest, a mixture of oil and water, is normally a good conductor, but when a current from the receiving pole passes through it it becomes, through the formation of gas bubbles, of high resistance. The flow of current is then interrupted, this alternate starting and stopping being made audible to the receiving operator through the medium of a telephone.

In this connection Mr. Peter Cooper Hewitt has just announced another application of the principle involved in his mercury vapor lamp, this time as an adjunct to wireless telegraphy equipments. The oscillating discharges from the sending station have hitherto been produced by a condenser discharging through air across the ordinary spark gap arrangement of two brass balls. This method, while fairly satisfactory, has always been a source of difficulty in one particular, namely, that the rate of oscillating or discharging varied tremendously with variations in the state of the atmosphere and the surface of the brass spheres. This variation is most objectionable in wireless telegraphy, as it prevents a receiving instrument being turned to receive impulses from a sender operating at a given rate of oscillation, a condition obviously impossible if the rate is constantly varying. Mr. Hewitt now finds that his mercury vapor tube makes a most excellent interrupter, producing a very large number of oscillations per second and at an absolutely regular rate of speed, two most desirable points. It would thus appear as if Mr. Hewitt had discovered a principle which will allow wireless telegraphy to make more pronounced progress, and which is entitled to be classed in importance with the original investigations of Mr. Marconi.

Electric Drive for Factories.

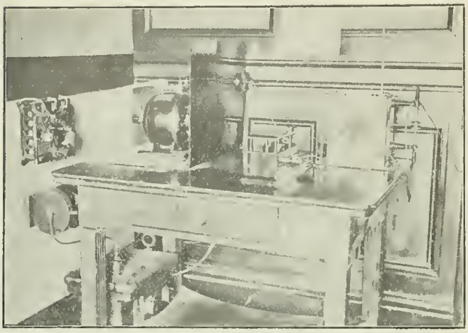
In bygone days the question of the motive power for a factory, either one in operation or one to be built, was settled with but very little discussion, one large prime mover, and perhaps very unfavorably situated at that, being the only plan available. Today there are several methods to choose from, each of which has its own particular field, but year by year it is coming to be more generally conceded that electrical driving has many points which entitle it to be considered as the most suitable in the large majority of manufacturing establishments. Users of power are divided roughly into two large classes, those who buy their power from some other public or private producer, and those who control their own steam or water plants. Those in the former division, aside from the fact that it is practically the only way in which power is offered as a commercial article, naturally use electrical machinery as their transforming agent because of its lower fire risk and greater cleanliness and convenience, but in the second case it is sometimes a moot point as to whether or no the expense of an electric distributing system is justifiable. Material for ordinary products represents approximately fifty per cent. of the cost of an article, labor or time in other less direct forms comprising some forty-five per cent. and power the balance. From this it will be seen that when considering the choice of a system mere economy of transmission is but a secondary feature, because the power item is such a small proportion of the total cost. On the other hand, presuming that any given method of power enables a reduction to be made in the item of labor, it will at once be evident that the aggregate cost will be materially affected, and modern practice is demonstrating more and more that the electric motor, by reason of the great facilities which it offers for a wide range of speed control, is a most satisfactory agent for producing this desirable end. There are, of course, a great many manufacturing processes which do not require variable speeds, but on the other hand there are an immense number which do, and to these latter the individual system of electric drive, a motor to each machine or tool, is peculiarly suited as offering a means of materially reducing the cost of the goods produced by greatly increasing the output of the various operators and the machines which they control.

The Cataract Power Company, of Hamilton, .Ont., are having plans prepared for an enlargement on an extensive scale of their plant at DeCew Falls. The proposed improvements will include the enlargement of both the power house and the canal.

Messrs. James Robinson, M.P., C.J. Coster and Thos. M. Robinson, of St. John, J. McDavitt and Edward Payson Brown, of New York, are applying for incorporation as the Aluminum Production Company of New Brunswick, Limited, with capital of $1,000,000. The chief place of business will be Newcastle, N.B.

THE DE FOREST SYSTEM OF WIRELESS TELEGRAPHY.

The attention of Canadians has been drawn to the De Forest System of Wireless Telegraphy by the experiments which are now being conducted for transmitting messages between Toronto and Hamilton, and the incorporation of the De Forest Wireless Telegraph Company of Canada, Limited. It was expected that a public test would have been made before this time, but arrangements have not yet been fully completed.



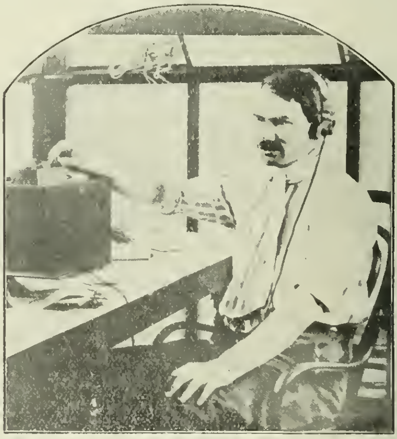
Transmitting Apparatus, De Forest System of Wireless Telegrappy.

The inventor of this system of wireless telegraphy is Dr. Lee de Forest, an American only twenty-nine years of age. He is a graduate of Yale University, where he studied electrical oscillation for six years. He entered the employ of the Western Electrical Company, of Chicago, and there continued his experiments. His first outdoor test was made in Chicago in 1901. Later he removed the scene of his experiments to New York. During the naval manoeuvres off the New England coast last summer, he established stations at Fort Wadsworth and Fort Hancock, which were bought up by the United States Signal Corps. The tests made under the auspices of the Navy Department are said to have been very successful, forty-eight words a minute being sent between Washington and Annapolis. These two stations are separated by thirty-six miles entirely overland, consisting of rough, hilly country heavily wooded. German and French wireless telegraph engineers who have essayed to cover this distance have pronounced it equal to 180 or 200 miles over salt water. The Slaby-Arco and Braun German systems and the Ducrete and Rochefort systems from France have all been tried over this range. Though exhaustive experiments were made, the Slaby-Arco system was, it is said, the only foreign system which was able to transmit intelligible messages, and this only after careful tuning of the two sets of instruments. The De Forest apparatus was in use by the Naval Board three weeks, and no difficulty whatever was experienced in covering the distance from the start. No tuning was required. This results from the extreme sensitiveness of the De Forest receiver and the positive and powerful action of the transmitter employed.

The De Forest anti-coherer, being a current-operated device, is best placed at a current loop or static node, that is, at the base of the antenna, which, it is said, accounts for its operating where the coherer, or potential-operative device, is uninfluenced. Inasmuch as the attaching of an earth connection to one side of the receiver compels a static node there, it was found that signals continued to be received, even when a length of wire, inductive or non-inductive, was inserted between it and the base of the antenna, even when this length amounted to that of the antenna, or more.

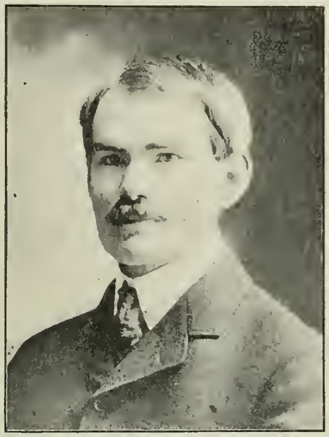
At Annapolis and Washington the Navy Department had masts 180 feet in height. From these hung a fan of five wires, of an average length of 200 feet. The ground connections consisted of two copper plates, 2 x 6 feet each, buried 6 feet below the surface. During the tests an officially recorded speed of 35 words the minute was maintained, and many of the test dispatches were in the Navy Code. Press dispatches were continually exchanged, and the value of "wireless" as a news transmitting medium was interestingly demonstrated when, after the runaway accident to Secretary of the Navy Moody, at Annapolis, the De Forest operators at Washington had the news to the press and the Navy Department fully thirty minutes before it was known by telephone or telegraph.

The ideas embodied in the receiver and sender have done away entirely with the coherer at the receiving station and the induction coil at the sending end. In the coherer heretofore almost invariably used as the receiving instrument in space telegraphy, the great drawback is the necessity for a tapping or decohering device, with the complication of apparatus this involves, its uncertainty of action, and, most important of all, the time lag, with limited speed of signal transmission thus made inevitable. To the new receiving device its inventor has applied the name "responder", a term first suggested as one suitable for any resistance device sensitive to electric radiations, regardless of any theory of the particular action involved. The device is not an "anti-coherer", for, although the action of the electric waves upon the new receiver is to cause a sudden increase in its resistance, similar to that observed with the arsenic or lead-peroxide "coherer", yet this effect is due to an entirely different action. Just what this action is and the mode of operation, as well as the full theory involved and the conditions governing, have been the subject of careful and painstaking scientific



Receiving Apparatus, De Forest System of Wireless Telegraphy.

research. The responder appears to be extremely sensitive in its action, and is instantly and automatically restored to its normal condition of high electrical resistance at the cessation of the Hertz impulse. This automatic restoring quality of the responder allows an ordinary telephone receiver to be used to good advantage at the signal receiving device. In this one hears, as it were, the sound of the spark at the sending instrument, for however rapidly these sparks follow one another, the responder restores itself to its original condition after each, and is thus able to respond to the succeeding impulse. Thus, by employing an induction coil and Wehnelt interrupter with an adjustible platinum anode, for the sending instrument, a sort of crude musical scale or siren can be operated, and the same note is heard ascending or descending, by one listening at the telephone connected in the responder circuit. In telegraphing, the receiving operator hears the dots and dashes of the Morse code in short or long "ripples", very much as the sending operator hears it in the sound of the induction coil's spark. This automatic restoring quality of the new responder, therefore, allows a speed of signal transmission limited only by the ability of the receiving operator to read. If desired, an ordinary relay may be substituted for the telephone and the signals received on the Morse sounder. The telephone is preferred, however, on account of the greater simplicity of the receiving circuit thus made possible, comprising, as it then does, beside the responder, only choke coils, the necessary resistance, a cell of battery and the telephone. The responder has been found to work best on a small current. Thus, with one ordinary dry cell several thousand ohms' resistance is included in circuit. The normal resistance of the device is about 50 ohms, increasing to 1,000 or more under the influence of the electric impulse.



Dr. Lee De Forest,
Inventor of the De Forest System of Wireless Telegraphy.

The De Forest system makes no claim to syntonic methods, but introduces several novel features. It is the only system using a generator of the transformer type; current from an engine-driven alternator having a potential of 500 volts is stepped-up by a commerical transformer to a voltage of 20,000 or higher, the oscillator is connected in series with the antenna and earth and is of the open-circuit type; the resonator is also of the B. C. type, and operates an anti-coherer, through a transformer, as in the Marconi, Braun and Guarini receivers; the impulses are translated into Morse by head telephones through the responder like that of the Slaby-Arco portable system.

THE BELL TELEPHONE COMPANY.

The annual meeting of the Bell Telephone Company was held in Montreal on February 26th. The statement for 1902 showed that 5,623 subscribers were added during the year and that the total number of sets of instruments now earning rental are 48,481. The company now owns and operates 377 exchanges and 553 agencies; 2,655 miles of wire were added to the Long Distance system in 1902 ; of these 1,042 are in the Ontario Department, 1,240 in the Eastern Department, and 373 in the North-Western Department. The long distance lines now owned and operated by the company comprise 26,848 miles of wire on 6,991 miles of poles.

The total receipts for the year were $2,085,134.26 and the expenses $1,580,831.39, leaving a net revenue of $504,282.89, from which was paid out $411,860.40 in dividends.

Officers and directors for the ensuing year have been elected as follows : C. F. Sise, president ; Hon. R. MacKay, vice-president ; Robert Archer, Hugh Paton, Charles Cassils, F. P. Fish, W. R. Driver and Thomas Sherwin.

Additional property adjoining the head office in Montreal has been purchased, and at an early date a new building will be erected to meet the requirements of the growing business of the company.

THE LINEMAN.

Thin scattered ranks of snow
  Stampede along the street,
And sagging wires betray the slow,
  Chill mischief of the sleet.
In homely garb of toil,
  With tools of quaint device,
The lineman comes, his shouldered coil
  Grey with a rime of ice.
Unpraised adventurer,
  He climbs enchanted towers,
And mends the magic threads that stir
  The world's remotest powers.
From heights wind-desolate
  His torch-flame cheerless blue,
(Red, red the hearth where loved ones wait
  The winter twilight through).
Lineman, what hindereth
  That message I would hear?
Canst mend the web 'twixt Life and Death ?
  Canst gain responses clear ?
I call, but still behold
  No spark of answering fire ;
Oh, for some lineman true and bold
  To mend that broken wire !

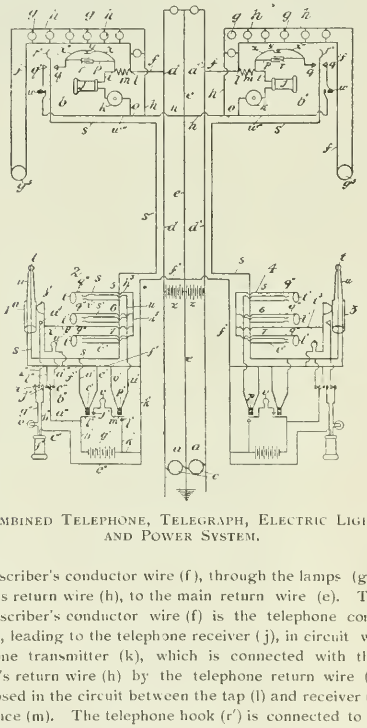
—William Hurd Hillyer, in Lippincott's Magazine.

The citizens of Sydney, N. S., recently tendered a banquet to Signnor Marconi, which was one of the most successful functions of the kind ever held in the Maritime Provinces. The dining room of the Sydney Hotel was beautifully decorated with flowers and the electrical display was on a most elaborate scale. At opposite ends of the table were placed two miniature Marconi towers, representing respectively the stations at Table Head and at Poldhu, Cornwall. Between these two stations an electric spark flashed at intervals, signifying the passing of wireless messages. The distinguished inventor, in responding to the toast of the evening. stated that the cost of establishing a trans-Atlantic wireless telegraph service was less than $200,000, while it cost $4,000,000 to lay an Atlantic cable. His company were under contract to transmit messages for ten cents a word, but he would not be surprised if in the near future wireless messages were flashed across the Atlantic at a cost of a cent a word.

COMBINED TELEGRAPH, TELEPHONE, ELECTRIC LIGHT AND POWER SYSTEM.

Mr. Alexander McMartin Stark, superintendent in Toronto for the Bell Telephone Company, has patented a novel system by means of which a subscriber is furnished with electric light, power and communication over the same circuit at the same time. In carrying out the purpose of the invention Mr. Stark uses a power current transmitted over a main power circuit and distributed at each subscriber's station to the subscriber's main circuit to furnish him continuously with current for his lamps, motors, and communication instruments and maintain this power current at constant tension by storage battery bridged across the main power circuit between the generator and subscriber's station. The accompanying drawing represents a diagrammatic view of a complete system of distribution.

In the drawing (a) is the generator station, which may contain any number of switchboards, and (b) (b') the subscriber's stations. Connecting the generator station with the subscriber's station is a three-wire circuit consisting of two main conductor wires (d) (d') and a main return wire (e). Tapping the main-conductor wire (d) and leading to the subscriber's station (b) is the subscriber's conductor wire (f), in circuit by means of the subscriber's return wire (h) with the main return wire (e). Connected in parallel with the subscriber's conductor and return wires are a series of lamps (g) and a motor (g^5). The electric current continuously circuits over the main-conductor wire (d) to the subscriber's conductor wire (f), through the lamps (g), subscriber's return wire (h), to the main return wire (e). Tapping the subscriber's conductor wire (f) is the telephone conductor wire (i), leading to the telephone receiver (j), in circuit with the telephone transmitter (k), which is connected with the subscriber's return wire (h) by the telephone return wire (o) and interposed in the circuit between the tap (l) and receiver (j) is a resistance (m). The telephone hook (r') is connected to the line wire (s), leading to the tip (t) of the plug (u), and connected to the line wire (s) is the conductor wire (a') of the signal-lamp relay (c').



Combined Telephone, Telegraph, Electric Light and Power System.

The subscriber's signaling device (w) is tapped on the subscriber's return wire (h) by the wire (w″), and when the receiver is on the hook (r') the circuit for the current is established over the line wire (s) from the central station through the hook (r'), contact point (q), subscriber's signaling device (w), and wire (w″) to the main return wire (e). Connected with the condenser conductor wire (p) are the wires (x) and (x″), forming the telegraph circuit, in which is interposed the usual telegraph instruments (y). Interposed on the condenser conductor wire (p), between the telegraph-circuit wires (x) and (x″), is a condenser (r), the purpose of which is to prevent the interrupted current of the telegraph instrument being transmitted to the receiver of the telephone instrument. When the receiver has been removed from the telephone hook (r'), the circuit from the central station is from the tip (t) of the plug (u), line wire (s), telephone hook (r'), contact point (q), condenser conductor wire (p), telephone conductor wire (i), receiver (j), and transmitter (k) to the telephone wire (o) and main return wire (e), and also over the telegraph circuit, the telegraphic messages being received and transmitted over the telephone circuit when the telephone hook is in this position. A similar system of circuits is installed in the subscriber's station (b').

Bridged on the main power circuit is a storage battery (z) to aid in maintaining constant pressure of the current as it circuits from the generator to the subscriber's stations and to remove the effects of the imperfect commutation of the generator and destroy the individual vibrations of the current by a neutralization of the same. At the subscriber's stations the current continuously passes over the subscriber's conductor wire (f), through the electric lamps (g) and motor (g^5), to the return wire (h) and main return wire (e). The current through the lamps and motor is not interrupted to any noticeable or appreciable extent by the cutting in of the telephone or telegraph instruments, or, in other words, the circuit of the current from the generator through the lamps and motors is continuous and of a sufficiently high potential to perform the work required of it. At the tap (l) sufficient current is taken off the power circuit to operate the telephone and telegraph instruments and passes through a resistance (m) to protect the telephone and telegraph instruments against its high potential. The current circuits continuously from the resistance (m) through the telephone conductor wire (i), receiver (j), transmitter (k), telephone return wire (o), to the main return wire (e). In the case of the telephone, the circuit of the current is constant through the instruments, while in the case of the telegraph instrument, the circuit of the current is interrupted until the telephone hook (r') engages the contact point (q).

Assuming that subscriber's station (b) desires to communicate with subscriber's station (b'), the receiver is removed from the telephone hook (r'), when a circuit from the generator (a) is established over the subscriber's conductor wire (f), resistance (m), condenser and telegraph circuits to the contact point (q), hook (r'), and line wire (s) to the signal lamp (v). The operator at the central station, after the lighting of the signal lamp, brings the contact points (i″) (j″) into engagement with the contact points of the branch wires (k″) (l″), respectively, forming a circuit from the line wire (s) through the operator's instrument at the central station and line return wire (l') to the main return wire (e), putting the operator's instrument into communication with the instrument at subscriber's station (b). The generator current from subscriber's station terminates in the tip (t) of the plug (u), and the operator on being requested to connect subscriber's station (b) with subscriber's station (b'), inserts the tip (t) of the subscriber's plug (u) into the jack (t') of the subscriber's station (b').

On the removal of the receiver from the telephone hook at subscriber's station (b') the circuit of the current through the signaling device is broken and is established over the condenser conductor wire and through the condenser to the telephone instrument and also over the telegraphic circuit and then over the telephone return wire to the main return wire (e). The subscriber at station (b) is now in communication with the subscriber at station (b'), the generator (a) continuing to furnish the current for the operation of the instruments, as well as for the operation of the lamps and motors at both stations. When the plug (1″) is inserted in the jack (4) the calling subscriber's spring (x') moves against the contact point (a^3), and establishes a circuit from the generator (a) over the line wire (s) through the disconnect lamp (w'), to the line return wire (l'), the spring (x') and contact point (a^3), forming part of the plug switch. When the generator circuit from the subscriber's station (b) is broken by the receiver being hung on the telephone hook (r') at subscriber's station (b), the circuit through the disconnect lamp (w') is broken and the operator is signaled that the instruments are no longer in use, and the plug (1″) is then disconnected from the jack (4) and returned to its socket.

Montreal is to be the headquarters of the Canadian Marconi Company, which is now preparing to install a wireless transcontinental service throughout the Dominion. Mr. John D. Oppe, of London, Eng., who is to become the manager of the Canadian company, is now fitting up a suite of offices in Montreal.

QUESTIONS AND ANSWERS

"Engineer": What is the rule for finding the horse power transmitted by leather belts? What is the proper speed to run them at? Which side should run next to the pulley?

Ans.—Various belt makers give different figures for the power which their products will transmit, but for average heavy double belts, running at four thousand feet per minute, a safe load is 10 to 12 horse power per inch of width. The power transmitted will increase or decrease in direct proportion to any change in this speed. A speed of 4000 feet per minute is considered good practice, speeds appreciably above or below it being considered on the one hand too high to give entirely satisfactory service, on the other too low to make the cost of belting come within reasonable limits. In single belts, the hair side should run next to the pulleys, on double belts you must run a hair side on both the inside and outside, because the two flesh sides are glued together.

"J. R.": Will a generator heat more on a load of say 500 kilo. volt amperes when the power factor is 100 per cent. and it is therefore delivering 500 k. w. to the circuit, than it will with the same apparent power but at a lower power factor, in which case the actual energy delivered is less?

Ans.—The heating will be greater in the latter case. This at first sight seems peculiar, but it is due to the fact that the less the power factor the greater is the magnetizing current required, from which it follows that the copper losses in the field, and all the iron losses, due to the increased magnetic flux, are both increased. The foregoing is true only if the decrease in the power factor be due to a lagging current, which we presume is the case in the machine you mention. If the current be leading, while the power factor will still be less than unity, the heating will decrease because the magnetizing current and flux will both be less.

"Marine Engineer": I want to put in a small lighting plant on a boat carrying 165 pounds of steam. Can I get a small engine to work off that pressure?

Ans.—It is not likely that any engine builder would care to sell his product to operate as a single cylinder engine off any such pressure, and a compound in any size smaller than say 100 horse power is not considered good practice, but you can get a plant which will give you good service by installing a redncing valve to bring your steam pressure down to say 80 or 90 lbs. Any ordinary single cylinder engine, condensing or non-condensing, will work on this pressure.

"Lineman": What is the difference between the drop and the loss in any given line of wiring?

Ans.—There is no difference in direct current work, they being identical. In alternating current circuits the loss is the power which is actually absorbed or lost in forcing the current through the wires, and is numerically equal in watts to the resistance of the line in ohms multiplied by the square of the current in amperes, which is also the rule for finding the loss or drop in direct current circuits. The drop in alternating current lines is the difference between the voltage delivered by the generator to the line and that received at the other or load end. It is equal to the volts consumed by the resistance of the line (the loss) plus that consumed by the reactance, which may or may not be considerable, depending on the size of the wire, the current passing through it, the frequency and the distance between the wires. It will thus be seen that it is always slightly greater than the loss, sometimes considerably so.

"Student": What is the meaning of the terms "long shunt" and "short shunt."

Ans.—The term short shunt means that in a compound wound machine the shunt field is connected directly to the armature brushes, in which event the current in the shunt field does not go through the series winding. In the long shunt the opposite is true, the shunt winding being connected to the other end of the series field. The terms are almost obsolete now. There is not much difference between the two methods of wiring, as far as actual operation is concerned, though the latter allows of the machines being excited direct from the bus bars, which is sometimes a desirable feature.

"J. King, Toronto": Can you inform me through your columns if water wheel governors have been controlled at a distance, electrically or by other means, anywhere in Canada or United States? If so, how is the same accomplished?

Ans.—The Lombard Water Wheel Governor Company have a type in which the speed is lowered or raised at will by a small motor, placed on the governor itself, and which is controlled by a switch placed at any convenient point, irrespective of the location of the governer; there may be more than one switch if it is found desirable to handle the governor from two or more points. The principle on which the device works is that the motor, when moved in one direction, shortens the length of the fulcrum on which the governor balls swing, when rotated the other way the opposite result is attained. The same device, with slight modification, can also be used to start or stop the wheel from any point desired.

"Reader": Will you kindly inform one of your readers if the larger companies throughout Canada use a double busbar arrangement on their switchboards and if these busbars are ever arranged so that they can be sub-divided. If this is done, can you tell me which of the larger companies in Canada use the arrangement?

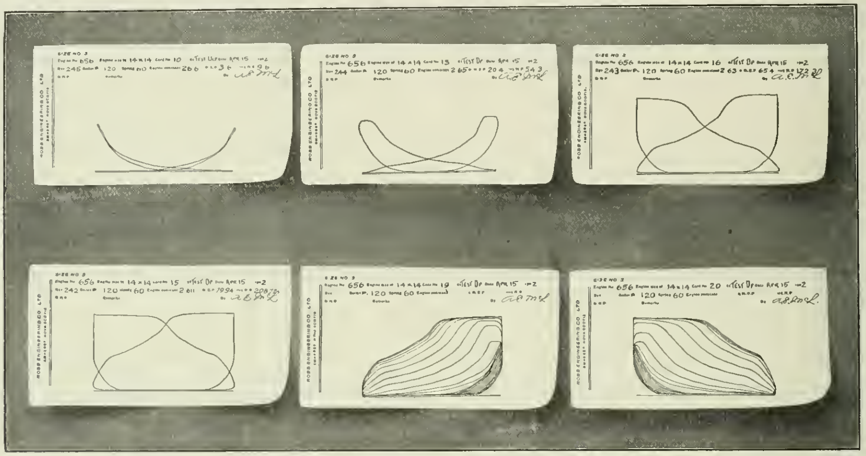
Ans.—The use of double busbar equipments cannot be said to be common practice in Canada, though some of the larger companies use it. Among them may be enumerated the London Electric Company, the Hamilton Electric Light Company, the Ottawa and Hull Power Company, the Jacques Cartier Electric Company and the Montreal Light, Heat & Power Company. The latter company is the only one as far as we are aware who in addition to having the two sets also have means of subdividing them.

INDICATOR CARDS.

We show on this page a set of indicator cards taken from a Robb-Armstrong single valve engine, which are almost as perfect as can be obtained from a four-valve engine.

These engines have a special form of rocker arm, designed by Mr. A. G. Robb, general supsrintendent of the Robb Engineering Company, by which the valve is moved more quickly at one end of its stroke than at the other, thus overcoming the irregularity in the time of admission and cut-off due to angularity of the connecting rod, which causes the piston to move faster at the back end than at the front end of the cylinder, and which in single valve engines with the ordinary valve gear, gives irregular indicator cards.

The Robb Engineering Company has recently issued a very attractive catalogue, fully illustrating and describing their engines, also giving views of some of the power plants they have erected in different parts of the world, and we have no doubt they will mail a copy to any person desiring one. Their address is Amherst, N. S.



Indicator Cards from a Robb-Armstrong Engine.

THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY.

The report of the Lachine Rapids Hydraulic and Land Company, of Montreal, submitted at the annual meeting on February 12th, showed a gross revenue for the year 1902 of $429,936.94, which was augmented by emergency revenue due to the Chambly dam accident to the amount of $36,027.64, making a total of $465,964.58. Discounts of $90,437.89 to customers reduced the total to $375,526.69. The operating expenses were $112,012.68, and the amount expended on betterments and repairs was $13,831.57, making a total of $125,844.25, leaving a balance of $249,682.44. After deducting interest charges and making provision for bad and doubtful debts there was left a net profit of $220,952.11. The addition of balance of profit and loss increased that amount to $228,733. Two half yearly dividends of 3½ and 4 per cent., amounting to $147,817.50, were paid, and the following contingent accounts were provided for: Written to credit of meter and arc lamp contingent account, $10,054.47; carried to contingent account, $30,000.00; carried to profit and loss reserve account, $36,027.64; balance carried forward to profit and loss, $4,833.39, a total of $228,733. The credit to the contingent fund on December 31, 1902, was $91,070. The percentage of total expenses decreased 4.75 per cent. last year, from 34.02 per cent. in 1901 to 29.27 per cent. last year. In 1899 they were 44.16 per cent.

The following statement of connected loads was submitted:

	1900	1901	1902	Increase.
Incandescent lamps.....	71,500	87,818	105,348	17,530
Alternating arcs........	205	321	392	71
H.P. of motors connected	2,716	3,280	3,699¼	389¼
Town of Lachine		150	185	35

In addition to the above, some fifteen fans and eight heating irons are connected.

There was expended during the year on account of capital $273,424.29. This includes steel floor in power house, conduit system and cables, cost of transmission, distributing lines, transformers, motors, switchboard, dams, head and tailraces, extensions to and connections with the Shawinigan station, out of which the amount of $21,817.92 was spent for meters alone.

During the year the company laid 20,371 duct feet of vitrified conduit, three hundred feet of 3″ wrought iron pipe and five manholes, and installed several ducts. There were placed during the year 19,397 feet of cable in the city and suburbs.

On the subject of inspection the report says: "Your directors regret that little or no progress has been made by The Canadian Fire Underwriters to ensure proper inspection of electric wiring and a better class of work. Your company is continuing to exercise, in so far as its interests are concerned, the greatest possible care, but our efforts seem to be fruitless and not appreciated by the Fire Underwriters, nor in some cases by the interested parties."

Officers have been elected for 1903 as follows: President, G. B. Burland; vice-president, Alex. Fraser; managing director, W. McLea Walbank; secretary-treasurer, Robt. Whyte.

At the annual meeting of the Citizens' Light & Power Company, Montreal, Messrs. G.B. Burland, Peter Lyall, W.M. Walbank, J. H. Burland, R. Wilson-Smith, M. P. Davis and L. H. Henault were elected directors, and at a subsequent meeting of the directors Mr. Walbank was elected president, Mr. J.H. Burland vice-president, and Mr. Robert White secretary-treasurer.

THE ENCLOSED ARC LAMP.

By Ralph Scott.

It is not the purpose of this article to elaborate on what has already been said regarding the enclosed arc, but merely to sum up in a general way, for the convenience of the average reader, the good points and principles of this type of lamp.

In the ordinary open-arc lamp the carbons burn or waste away so rapidly that for a single night's illumination (with the series street lamp) two sets of carbons are required. Hence the advantage of the enclosed lamp, in which a single set of carbons burns from 150 to 200 hours. In order to accomplish this it is merely necessary to enclose the carbons, or at least the arc, in a glass globe, so that the outside air will have no chance to act on the carbon at the arc. If this be done with a series lamp, however, it will be found that the light given off is greatly decreased, the reason for which will be explained later. If all the air be excluded from the arc, it will be found that the disengaged particles of carbon will float around in the globe and finally deposit themselves upon the sides and bottom of the globe and in a short time shut off a great deal of light from the arc. It is therefore obvious that a little air is necessary to circulate in the globe or bulb, so that this uncombined carbon may be oxidized. Moreover, if the globe were made perfectly air-tight the expanding gases would cause an explosion. The combination of the carbon and the air forms carbon dioxide, which is harmless so far as blackening the globe is concerned.

In order to obtain this limited supply of air, a small opening should be left in the globe or above it, through which a small quantity of air may find admission. This may be accomplished by leaving a small air space between the upper carbon and the cap into which it slides. On no account must an opening be left in the bottom of the inner globe, since the globe will then act as a chimney and the carbons will be consumed much faster. It is therefore important to have no nicks or cracks in the bottom of the inner globe.

Even when a little oxygen or air is admitted to the globe a small quantity of silicon and calcium, which are found in even the purest carbons, will form on the inside of the globe and shut off a little light, but in some cases this seems to improve the color of the light. This deposit may be readily washed out by dilute hydrochloric acid every few months, and will not be found to give much trouble. Sometimes this acid seems to attack or affect the glass in such a way as to greatly increase its liability to crack by uneven heating; therefore, it should only be used when absolutely necessary.

In the open arc, if the upper carbon be raised so as to increase the potential across the arc to 80 volts, it will be found that a flaming, hissing and very wide arc is the result, and the carbons will waste away very rapidly owing to the free access of the oxygen of the air to the arc, which now gives off a great amount of heat, but very little light. If the arc were enclosed the action would become entirely different, the arc assuming a quiet, non-hissing, non-flaming condition, because of the greater number of uncombined carbon molecules; and, being more compact and offering more resistance, the arc gives much more light and less heat. The light produced by an enclosed arc is due chiefly to the incandescence of the carbon vapor, while in the open arc the light given off is produced chiefly by the incandescent carbon tips, which are heated by the combustion of the carbon vapor.

As a higher voltage is required to force current across the longer arc of the enclosed lamp, the e. m. f. may be advantageously increased to 80 volts in a 5-ampere lamp; in fact, it must have this potential across the arc or it will not yield the characteristic results of this type of lamp. All attempts at changing series lamps into multiple enclosed lamps have been failures for this reason. Some lamps may be adjusted to increase the length of the arc sufficiently, but in most types this cannot be done, and an enclosed lamp having only 50 or even 55 volts across the arc is a failure, since it sometimes gives only a little more light than an ordinary candle.

A 3½-ampere enclosed-arc lamp, with 80 volts across the arc, gives about the same effective light as a series lamp using 7 amperes at 45 volts, so that the efficiency is much in favor of the former type. Enclosed lamps are generally connected in multiple across 110 and 220-volt circuits and in series of two and five across 220 and 550-volt mains. The standard 220-volt lamp takes 155 volts across the arc and passes 2½ amperes; the 110-volt lamp takes 80 volts at 5 amperes, the length of the arc in the latter case being about 13/32 in.

In an enclosed-arc lamp with a shunt coil, the dash-pot must be stronger than in the series lamp with a shunt coil, so that the movements of the carbon will not be too sudden or spasmodic. If this provision is not made, the arc will be disrupted or broken, causing the lamp to "wink." In the alternating-current lamp, on account of the low heat of the arc and its tendency to blow itself out, the damping or dashpot action must be very slow, and the moving parts must have considerable weight, which provision is unnecessary in direct-current lamps. The disadvantages of alternating current arc lamps are singing at the arc and in the mechanism and poor regulation; in later lamps, however, these troubles have been reduced to a considerable extent.

Another point worth consideration is the hissing in arc lamps. This pecularity is seldom observed in an enclosed-arc lamp except at the start while the inner globe is full of air. Hissing is due to several causes, chief among which are the following: The carbon, especially at the crater, is in a state of ebullition; if the current taken by the arc is great, or if the arc be very long, the arc, having so much surplus vaporized carbon, is attacked, especially at its widest position, by the oxygen of the air, resulting in minute explosions or combinations of this carbon oxygen, which occur with such great rapidity as to cause a hissing vibration; if the current used is too great, however, the noise of the arc will then assume a humming or purring character.

In the enclosed type the distinction between the crater and cone is not very marked; in fact, it is almost impossible to tell the difference between the positive and negative carbon tips, both having a rounded appearance. At the moment when the current is shut off from the lamp, it will be noticed that the positive carbon tip is the hotter or stays red the longer, which is the test applied to determine whether the lamp is connected correctly or not. When taken out, the carbon tips possess a smooth, perhaps polished appearance, and are generally cracked. The carbons should never be rough, as this indicates that too much air gets into the inner globe.

The carbon tips from the non-hissing open arc possess the following properties : The cone is tapered to an angle of about 70 degrees and has a small knob of carbon deposit at its end ; the crater is uniformly hollowed out and covers the greater part of the end of the positive carbon, and there are no fringes on either tip. If the tips do not show these characteristics, then it may be assumed that the arc has been hissing or has been passing too much current.

A curious effect in an arc-lamp circuit is the following : Upon opening the circuit there is seldom more than a very small arc at the switch. The reason for this is that any arc, however small, quickly introduced in series with a lamp will immediately break the circuit. For this reason a considerable number of arc lamps will give no more spark at the switch break than an equal number of incandescent lamps. Hence, the switch will not have to stand a very heavy arc on opening the circuit. By reason of this feature, considerable economy may be effected by using snap switches for this purpose, this type of switch having a longer life than others.

The following rules should be observed by those who have any arc lamps under their charge or attention :

1. Always have the top carbon positive, that is, hottest.
2. Never allow the dashpots to stick.
3. See that the upper carbon does not bind.
4. See that the clutch works reliably and smoothly.
5. Throw all cracked, "run" or nicked inner globes away.
6. Keep all contacts tight.
7. Use no undersized or crooked carbons.
8. Keep asbestos washers in perfect condition.
9. Always have strong supports for suspending the lamps.
10. Do not allow resistance wires or coils to sag.

—American Electrician.

WATER POWER IN FRANCE.

An event marking a new era of prosperity for Grenoble and the region of the Dauphine was the holding in September of this year of a "white coal" convention. More than 500 prominent men of science —engineers, polytechnists, mill owners and manufacturers—from France and other countries assembled in the Chamber of Commerce building and devoted their time to a thorough discussion of the utilization of the water power of the glaciers and mountain streams of Alpine France. During the week excursions were made in different directions within a radius of 50 miles to inspect the score or more of factories, where the water is already utilized for the generation of electricity, the making of paper, soda, aluminum, acetylene, and chemical products of various kinds, and in general for the distribution of force.

The railroads of France (25,000 miles) employ about 4,000,000 horse power and the other industries about 2,500,000 horse power—a total of 6,500,000 horse power produced by steam. M. Berges estimates the hydraulic forces of France in her mountainous regions to be 10,000,000 horse power. Even at a much reduced estimate, the measure of industrial development possibly can readily be seen.

The streams and cascades have been used to a certain extent for years, but not until recently, under the leadership of such enterprising men as Berges and Joya and Desprez, has this water been "canalized"—conducted by huge pipes from vast heights down the mountain sides—and, with the aid of turbine wheels, made to develop tens of thousands of horse power and to distribute energy, heat and light in all directions.

It is a striking fact that the mighty energy cradled in the glaciers of the mountains and lying dormant through the centuries should be suddenly set free and made to turn the wheels of a hundred industries to meet the needs of man. The glaciers are a mine of "white coal" which, unlike the product of the earth, is inexhaustible, renewing itself from year to year. In 1863, it was deemed a bold achievement to bring water from a height of 260 feet, as at Uriage ; but now M. Berges has succeeded in canalizing a fall of 1,640 feet and another of 1,804 feet. At Epierre (Savoie), M. Joya used a fall of 1,935 feet and at Chapareillan (25 miles from Grenoble) another of 2,040 feet—until this year said to be the highest single fall in the world.

At Lancey, a few miles northeast of Grenoble, the water which gives power to mills of various kinds and to the electrical plant which lights the valley of the Graisivairdan and maintains its several tramway systems is brought by three successive falls whose total is 6,560 feet.

Light is furnished to the houses and farms of the vicinity at a very moderate cost ; for example :

First lamp, 10 candlepower, per year..........	$4.82½
Second lamp, 10 candlepower, do..............	2.89½
3 lamps of 5 candlepower each, do.............	2.89½
Total for 5 lamps, 35 candlepower......	$10.61½

An average of $2.12 per lamp per year.

Starting from the little lake of Domenon, among the snows of the peak of the same name, the water is drawn by pipes which tap the lake at its bottom and is carried to a lake lower down the mountain, and from this still farther down to a third lake, whence the conduits bear it, always at a certain gradient, to the factories below, where it yields an equivalent of 10,000 horse power.

As illustrating the enormous pressure of the water thus canalized, the pipes in many cases (as below) are as much as 3 meters 30 millimeters, or 10.83 feet, in diameter. The tunnel under the Thames at London has a diameter of about 11 feet, but this is for a distance of 30 meters, or 98½ feet, only. The Societe Hydro-Electrique de Fure et Morge at Grenoble, which utilizes the waters of the torrent Drac, near Vizille, has 4,600 meters, or 15,092 feet (of which 8,200 feet are in steel plates and 6,892 feet in wired cement), of piping with a diameter, as stated, of 10.83 feet.

This installation permits the distribution of force to the extent of 3,500 horse power, under a tension of 26,000 volts, for a distance of 40 miles to factories in Moirans, Voiron and Rives.

Grenoble will soon be lighted by electricity, the power being supplied by the Electro-Chemical Society of the Romanche, which has its works in the village of Livet (altitude 1,794 feet), 27 miles distant from this city. The valley of the Romanche was, until recent years, sparsely populated ; to-day, within a distance of 12 miles, there are already installed six establishments for the making of paper, wood pulp, acetylene, aluminum, etc., and for the generation of electric force.

The stream itself is fed by the powerful glacial reservoirs of the Massifs of the Belledonne and the Pelooux—ranges of mountains (in altitude from 9,800 to 13,000 feet) on either side of the valley ; and in winter and summer alike, this water supply is unremitting and abundant.

With Grenoble thus lighted as it were by the melting snows, and furnished with a new motive force for turning its industrial wheels, it may well deserve its title of "the White Coal Capital."—Report of C. P. H. Nason, U. S. Consul, at Grenoble.

STEAM ACCOUNTED FOR BY THE INDICATOR.

The expression which forms the title of this article is frequently used in connection with the reports of engine tests, and it sounds very complicated to the amateur engineer, but it refers to one of the most simple things that are given high sounding names.

If none of the steam was wasted on its way to the cylinder, nor in the cylinder after it arrives there, the steam accounted for by the indicator would equal the amount of water pumped into the boiler, but the difference is frequently 30 per cent., and sometimes it is much more.

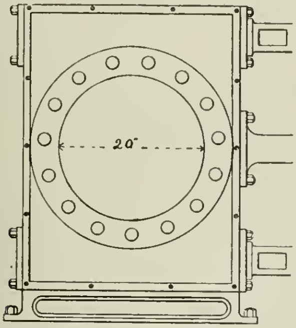


Fig. 1.

However, we do not need to trouble ourselves about this difference now, as the two qualities refer to different things altogether, which have no connection in many cases.

The cylinder of a steam engine measures the steam out of a boiler the same as a milk man measures milk out of his large cans with a quart measure. When we know the amount taken out at each stroke and the number of strokes per minute, we can decide how many cubic feet are used in that time, and multiplying this by 60 gives the consumption per hour, in cubic feet. Finding the weight per cubic foot due to the stated pressure, and multiplying these two factors together, gives the weight used per hour.

The process is illustrated as follows: Let Fig. 1 represent the cylinder of an engine, with the head removed. Measuring this we find it 20 inches in diameter. The area is 20 x 20 x.7854, equals 314 square inches.

Replacing the head and proceeding to take a diagram gives the result shown in Fig. 2. There are two ways of measuring the steam that are commonly used in practice, one of which is to find out how much is used up to the point of cut-off, and the other is to take the whole capacity of the cylinder, using the terminal pressure for this purpose. We believe this is the best plan, but will explain the other first.

The point of cut-off took place at seven-eighths of an inch from the end of the diagram, which was originally four and one-half inches long. This means that the cut-off took place at one-fifth stroke. As this engine has a stroke of forty-two inches the cut-off took place at 8.4 inches, therefore in order to find the cubical contents of the cylinder up to the point of cut-off, the area in square inches is multiplied by the length traveled by the piston when the cut-off valve closed, and as the result should be stated in cubic feet it is necessary to divide by 1,728. Then 314x8.4÷1,728=1.526 cubic feet.

This engine revolves eighty times per minute, making 160 strokes. Then 1.526x160=244.16 cubic feet per minute, or 14,649 per hour.

There was a No. 40 spring in the indicator when this diagram was taken, therefore by measuring from the atmospheric line to the point of cut-off, with a No. 40 scale, the pressure is found to be 98 pounds, but we must know the absolute pressure for all of these calculations, which is 15 pounds more than the gauge pressure in all places near the sea level, and 98+15=113 pounds.

One cubic foot of steam at 113 pounds pressure weighs .2586 pound, therefore the total weight per hour is 14,640x.2586=3,875 pounds.

The area of this piston is 314 square inches, and its speed is 560 feet per minute, therefore the horse power constant is 314x560÷33,000=5.328. The mean effective pressure is 52.4 pounds, therefore when this diagram was taken the engine was developing 5.328x52.4=279 horse power. Dividing the total weight accounted for by the horse power developed shows that 3,786÷279=13.5 pounds are accounted for per horse power per hour. This is a very low result, but is correct according to this rule. If we add 30 per cent. for condensation, etc., it brings the total up to 17.5 pounds per hour for each horse power developed.

Proceeding to illustrate and explain the rule for finding the water accounted for, taking the pressure at release, or in other words at the end of the stroke, we must find the cubical contents of the whole cylinder. The area is 314 square inches and its length is 42 inches, therefore 314x42÷1,728=7.63 cubic feet per stroke.

Another way to calculate the contents is to multiply the number of cubic feet to the point of cut off, by the denominator of the fraction used to designate the point of cut off as a part of the whole stroke. In this case it is 1-5, therefore 1.526x5=7.63 cubic feet per stroke as before.

This means 73,248 per hour at 27 pounds pressure, as this is the absolute terminal pressure shown by this diagram, and its weight is .0673 pound per cubic foot. This accounts for 73,248x.0673=4,929.59 pounds per hour.

As the engine develops 279 horse power the indicator accounts for 4,929.59÷279=17.66 pounds per horse power per hour. If we add 30 per cent. for leakage, condensation, etc., it makes a total of 22.95 pounds per horse power per hour.

This is probably right for this engine, although it is a good record for a non-condensing engine. The high pressure and economical point of cut-off are in its favor.

The rule which determines the water used by taking the pressure at release seems to be the best, because it takes account of any steam that may leak in after the cut-off valve closes, still it does not show the water wasted by a leaky exhaust valve. We have omitted the clearance in this illustration.—W.H. Wakeman, in the Tradesman.

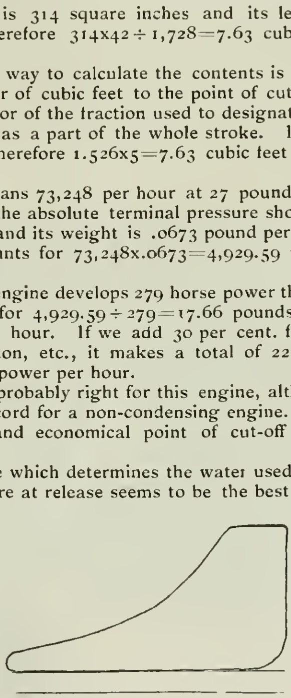


Fig. 2.

NOTICE.

The Sherbrooke Street Railway Company is looking for a competent man to take charge of car repairs. He must be familiar with General Electric equipment and understand winding armatures.

Second-Hand

1—50 Light T. & H. Arc Machine 12 C. P.
1—Spare Armature.
1—Spare Commulator.
30—Double Arc Lamps.
Regulator, etc., complete, all in good condition.
Price, five-hundred dollars ($500.00) net cash.

THE R. E. T. PRINGLE CO.,
Montreal, Que.

HAMILTON ASSOCIATION STATIONARY ENGINEERS.

An open meeting of Hamilton Association of Stationary Engineers was held in the Sons of England Hall early in February, which was well attended. Mr. Thos. Elliott, the chairman, after a few preliminary remarks, introduced Mr. Geo. Chantler, who gave a very interesting address on "Combustion of Fuel".

The subject, the speaker said, had occupied his attention almost twenty years, and as the result of his investigation, he had made a departure from the principles as taught in Schools of Science to-day. He then defined the elements in combustion.

The atmosphere is the great fuel supply of the world. One pound of carbon requires two and two-thirds pounds of oxygen to form combustion. The atmosphere is said to be a mixture of three elements. The speaker thought that air is a compound, just as water is a compound, as the proportions of the three elements are always the same, and are held in combination by fixed laws.

In this compound there are two elements that perform important functions, the oxygen unites with the coal and produces heat, but the heat generated is in the ratio of the amount of oxygen consumed. Nitrogen, under certain conditions, is combustible. With hydrogen it will produce combustion, and the result will be water. The water will be slightly acid. showing that the nitrogen has entered into the compound, this showing that nitrogen is combustible. In order to produce combustion it is necessary to bring these elements together under certain conditions. Elements such as those above mentioned show evidence of heat by color. At from 1200° to 1400° the color changes to a cherry red. It assumes a deep cherry red at from 1600° to 1800°. At 1900° it assumes an orange shade, and at 2000° white heat; at 2500° it is dazzling. The color indicates the temperature of the fire. To produce combustion at least 1000° are required, at 1400° combustion is more rapid, at 1600° it is quite rapid, and so on increasing as the temperature increases.

Nitrogen might be called the stoker, it enters into the fire in combination with the oxygen, and when these two elements come in contact with the heated carbon or hydrogen they are separated at the place where combustion takes place. Nitrogen is not only the stoker that carries the oxygen, but it is a great absorbent of heat, and also conveys that heat to the surrounding bodies and carries it to the point at which it is to be utilized.

The analysis of coal shows that it contains about 85 per cent. carbon and 5 per cent. hydrogen; of the carbon about 35 per cent. is free carbon. This free carbon and hydrogen when heated pass off through the chimney as smoke. If this can be burned, a great saving of fuel will be the result. Just along the front edge of the fire you have the flame of combustion, over your fire bed the flame of incandescent gas, and no combustion can take place at this point because there is no oxygen and also because carbon dioxide is present. Carbon dioxide will distinguish fire, and you cannot support combustion in the absence of oxygen. If this carbon dioxide can be eliminated, and a supply of oxygen supplied, then this smoke can be burned, and a great saving of fuel, as has been said before, will be the result. Then to burn coal to the best advantage, it is necessary to bring it in contact with two supplies of oxygen, and these must be distributed properly over the fire bed. The point is this, adjust your plans so that you bring heat and air together to consume the gas as it is liberated, and then bring another supply to burn your coke. The conclusion is that to burn soft or hard coal, burn it from the top, with a top draft, and in this way you can retain it and transmit it to the point where it is to be utilized.

At the conclusion of the address it was moved by Mr. R. C. Pettigrew, and seconded by Mr. W. Sweet, and unanimously carried that the thanks of the meeting be extended to Mr. Chantler for his valuable contribution.

THE ECLIPSE GASOLINE ENGINE.

Our readers will note the advertisement of D. McKenzie & Company, of London, Ont., on another page of this issue. This company's works at 298 Richmond street are now turning out stationary, marine and automobile gas and gasoline engines.

With a keen appreciation of the necessities of the market they have designed the Eclipse engine, and offer it as their result of many years' experience in gas engine construction. Great simplicity is the characteristic of the engine.

The governor is the well known Eclipse throttling type, and has been used with marked success for the most exacting service, and on engines used for driving dynamos for incandescent lighting. The speed of the engine may be quickly changed to any speed, or intermediate speed, from 100 to 800 revolutions per minute, by simply moving a small screw on the governor while the engine is running. The crank shaft is the best grade of steel, the throw being turned from solid metal, which adds to the strength of the crank. The igniter, which is an important part of any gas engine, is of the improved Eclipse electric tpye and it is claimed works perfectly in all kinds of weather.

A new switch-board will be installed this year by the Corporation of New Westminster, B.C., and later in the year it will probably be found necessary to make further additions to the electric plant.

THE
"TRITON"
—MARINE—
Gasoline Engine
Simplest, Safest and
Most Reliable.

Hamilton Motor Works
Hamilton, Canada.
258 Catharine Street North.

"Engines in successful operation from
Halifax to Vancouver."

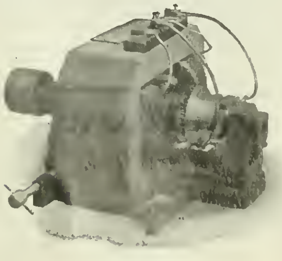
Electrical Repair & Construction Co.
Electrical Contractors

We manufacture Electrical Machinery for Plating, Lighting and Power, from ¼ to 10 h.p.

We have Electric and Water Fans and all Electric Supplies.

Send for estimates and prices to

40 Sheriff Street
Cleveland, Ohio.
Dynamos and Motors Repaired.



SPARKS.

The Canadian Casualty & Boiler Insurance Company has been incorporated with power to carry on business in Ontario. Special attention will be given to insurance of boilers. Mr. A. C. C. Dinnick is manager of the company.

Mr. H. B. McGiverin, of Ottawa, has made application to Parliament for a charter for a steam or electric railway to be constructed between Toronto and Hamilton. The names of those behind the scheme have not been announced.

Parry Sound, Ont., has a municipal electric light plant, recently purchased from a private company. The result of the first year's operations has not been very satisfactory, as according to a correspondent of the North Star, a deficit is shown of $1,621.58. The expenses were $7,694.84 and the revenue $6,073.26.

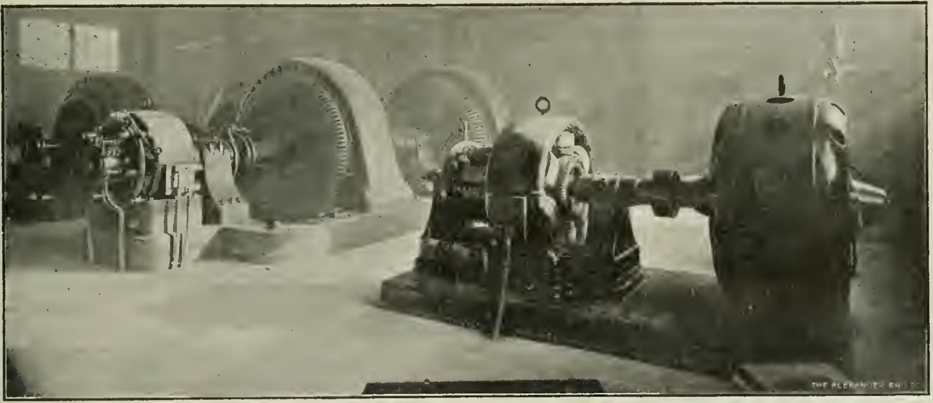
Owing to a technical flaw in the by-law passed by the town of Berlin authorizing the purchase of the gas and electric light systems, the purchase money cannnt be paid over for the period of three months. Meanwhile the council are trying to arrange with the present owners to allow the works to be taken over and operated at once by the municipality, which will probably be agreed to provided proper guarantees are furnished.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIII. APRIL, 1903 No. 4.

THE TRANSMISSION LINE AND TERMINAL STATION OF THE SHAWINIGAN WATER AND POWER COMPANY.

In respect to distance and voltage the electric transmission system of the Shawinigan Water & Power Company, which has recently been put into operation, is the most important in Canada. The current is transmitted from Shawinigan Falls to Montreal, a distance of almost eighty-five miles, at a pressure of 50,000 volts. As it is hoped to publish at a later date a comprehensive description of this plant, brief mention only will here be made of the water power development and generating apparatus. The source of supply is the Shawinigan Falls, on the St. Maurice River, where the peculiar formation of land permitted of a remarkably cheap development. A canal 850 feet long, 100 feet wide, and 40 feet deep, diverts a volume of water sufficient to produce 75,000 horse power.



FREQUENCY CHANGERS AND MOTOR GENERATOR SETS IN TERMINAL STATION OF SHAWINIGAN WATER & POWER COMPANY, MONTREAL.

The water wheels have a capacity of 6,000 horse power under a head of 125 feet, and were made by the I. P. Morris Company, of Philadelphia. The generators are of the Westinghouse A. C., two phase, 2,200 volt, rotating field type of a capacity of 3,750 k. w. The current is converted into three phase and by means of step-up transformers is raised to 50,000 volts for transmission, the frequency being 30 cycles.

THE TRANSMISSION LINE.

The transmission line is 84 3-10 miles long, measured from the generating station at Shawinigan to the terminal, or distributing station, in Maisonneuve, a suburb of Montreal. After running across open country for a distance of four and a half miles from the power station, the line comes out upon the Great Northern Railway of Canada, and from this point it runs westward through a number of villages and towns, until it reaches the important manufacturing town of Joliette, a distance of 45 miles. From Joliette to Montreal the line follows the right of way of the Joliette-Montreal branch of the Great Northern Railway to the village of Charlemagne, on the bank of the Ottawa river, opposite the Island of Montreal. After crossing the river the line follows the course of the Montreal Terminal Railway until it reaches the terminal or distributing station in Maisonneuve. For eighty miles of its length the line parallels the railway at a uniform distance of 43 feet.

The line consists of approximately 4,500 cedar poles, 10 inches in diameter at the base and 7 inches at the top, with a minimum length of 35 feet, the poles being set six feet in the earth, and in line at a distance of 100 feet apart. The cross-arms are of Georgia pine 4¾ inches square and 6 feet long, treated in liquid asphalt. On three pins 2½ inches in diameter and 18 inches long are mounted white porcelain insulators. There are approximately 14,000 insulators, each weighing fifteen pounds, which have been tested to over 100,000 volts.

Each of the three transmission cables is composed of seven strands of No. 6 B. & S. gauge aluminum wire, one strand forming a straight core, around which are twisted the remaining six wires. The diameter of the cable is one-half inch, and it weighs a trifle over 2⅔ ounces per lineal foot. As there are seven wires in each of the three cables, it follows that 1,771 miles of aluminum wire were used on the entire line, and that the total weight of wire used on the entire line was over 250,000 lbs. The two lower cables throughout the transmission line run at an approximate height of 26 feet from the ground. The ends of each length of cable are joined by means of the "McIntyre" sleeve joint, an oval aluminum tube, with inside diameter of ½ x 1 inch and a length of 9 inches. The junction is effected by slipping the ends of the cables inside the oval tube, and then twisting the tube, thus by friction firmly binding together the two lengths of the cable.

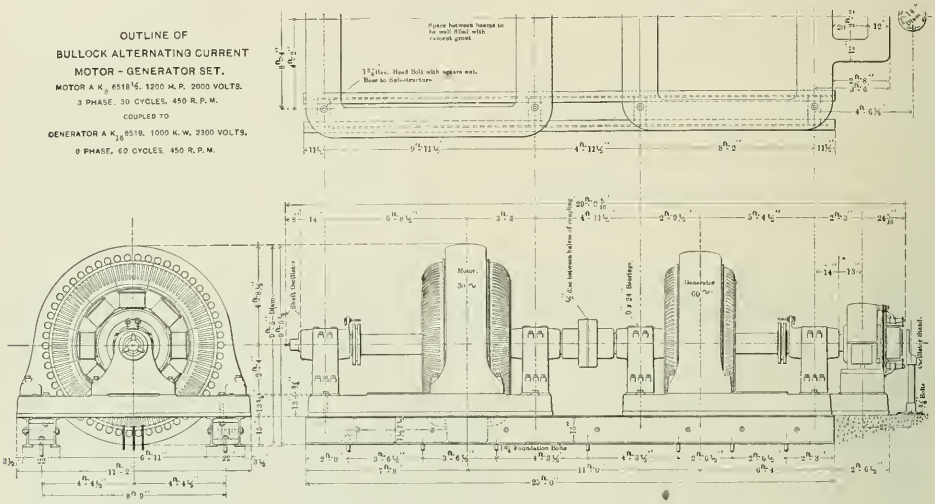
At a distance of fourteen miles from Montreal, the line is carried across the Ottawa River, but as the construction of the Great Northern Railway bridge (over which it was originally intended the line should be carried) was not far advanced, it became necessary to erect a temporary line and advantage was taken of the presence of an island in midstream, which made possible the crossing of the river by two spans. Each stretch of the river's width is now spanned by three 1-inch steel cables, which are supported on four towers, each 90 feet high. The cables have a tensile strength of 125 pounds per square inch ; the spans are 1,200 and 1,850 feet long respectively. Under the present arrangement, the current on arrival at Charlemagne is transferred from the aluminum to the steel cables ; through the latter it crosses the river, and at the other side passes from the steel to the aluminum cables. The insulators placed on the towers for the support of the steel cables were made to sustain the enormous strain of the cables as well as to serve as insulators—they are very costly, and were specially prepared only after the most careful calculations and tests had been made. Upon the completion of the railroad bridge across the Ottawa River, aluminum cables will be strung across that structure, and the steel cables now spanning the river will be retired from use.

THE TERMINAL STATION.

As the Shawinigan Company could not enter the city of Montreal without permission of the council, a transforming station was built in Maisonneuve on the outskirts, where the current is by arrangement handed over to and distributed by the Lachine Rapids Hydraulic & Land Company, which has recently been absorbed by the Montreal Light, Heat and Power Company. This terminal station is built of brick in the form of an oblong square, the dimensions being about 95 feet x 115 feet. The trusses are of steel, the roof and floors of concrete and steel. The station is divided into two unequal parts by a heavy brick wall running lengthwise throughout the building. The Lachine Company occupies a specially constructed wing of the building, where is located the switchboard, etc., largely of Westinghouse manufacture. In the smaller division are the step-down transformers of the static or stationary type, with a working capacity of 2,800 horse power each. The transformers, encased in cylindrical tanks 15 feet high and 7½ feet in diameter, are surrounded by oil, each tank holding 750 gallons. The pressure of 50,000 volts, at which the current is transmitted from Shawinigan Falls to Montreal, is reduced to 2,200 volts to conform with the voltage used by the Lachine Company.

The main division of the station is occupied by the frequency changers and motor generator sets, manufactured and installed by the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, and shown on the previous page. At present there are installed only two frequency changers, each of 800 k.w. normal output, but capable of developing 1000 k.w. Two more sets identical with those installed are in process of manufacture and nearly completed. Attention might here be drawn to the method of placing these machines upon a solid foundation. In view of their great length and weight it was deemed advisable to use " I " beams for the sub-bases, the beams being filled in solidly with concrete.

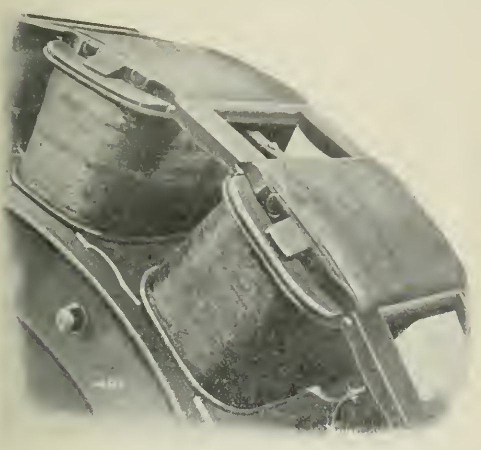
One of the main features is the unique yet simple


OUTLINE OF
BULLOCK ALTERNATING CURRENT
MOTOR - GENERATOR SET.
MOTOR A K3 6518½. 1200 H.P. 2000 VOLTS.
3 PHASE. 30 CYCLES. 450 R.P.M.
COUPLED TO
GENERATOR A K16 6519. 1000 K.W. 2300 VOLTS.
0 PHASE. 60 CYCLES. 450 R.P.M.
Space between beams to be well filled with cement grout
1¾ Hex. Head Bolt with square nut. Base to Sub-structure
Motor. 30 ~
Generator 60 ~
Shaft Oscillator
Oscillator Stand
Foundation Bolts

Dimensions of Frequency Changers, Shawinigan Water and Power Company.

method of starting the frequency changers or motor generator sets. This is accomplished by means of a 100 h.p. 60 cycle 3-phase motor direct connected to an 85 k.w. 120 volt generator. In this station 60 cycle 3 phase is always available from the circuits of the Lachine Rapids Hydraulic & Land Company. The exciters on the frequency changers are used as motors in starting, the source of current coming from the motor generator set above referred to. As soon as the 30 cycle motor of the frequency changer is synchronized and thrown upon the circuit, the 60 cycle motor generator set is thrown out of circuit and the exciter of the large set runs as a generator, which excites the fields of both machines of the frequency changer. By means of throw-over switches this one small 60 cycle motor generator set will start any number of frequency changers.

The third illustration shows the dampers placed upon the fields of both generators and exciters, which insures speed being constant with either machine of the frequency changer operating as a motor ; thus, in case of any difficulty at Shawinigan the 60 cycle machine can be operated as a motor from Lachine Rapids current, delivering power at Shawinigan Falls.



Section of Rotor of Bullock Generator, Showng Dampers.

SPEED REGULATION OF INDUCTION MOTORS.

The simple induction motor is essentially a constant-speed machine. This feature of its operation has many times been urged against its use for many applications.

Means of varying speed have been known, but while these were very effective they brought in objectionable features. Since the speed depends upon the frequency, it of course could be varied by variation in the frequency. This method, says the Electrical Review, is not generally applicable, requiring as it does as many generators as there are changes in speed. By using two motors and combining these in cascade or concatenation several speeds can be obtained, but the efficiency of the system is poor and the need for installing two motors is objectionable.

Where but two or three changes in speed are called for, these can be secured efficiently by winding the motors so as to allow for a change in the number of poles. The changes are in steps and not gradual.

The most generally applicable method of varying the speed of induction motors has been rheostatic control. By inducing non-inductive resistance into the secondary of the motors the speed can be varied at will and the available turning effort of the motor is not decreased. This method is unfortunately very inefficient, as the total energy absorbed by the rheostat is wasted and this varies proportionately to the reduction in speed. For intermittent work, however, and for starting motors under load, the method has found a wide use.

Recently a number of foreign papers have described a new means for securing this desirable speed variation without involving the objections pointed out above. If we reduce the current in the secondary by means of a counter-electromotive force instead of by the non-induction resistance just described, the speed of the motor can be reduced accordingly. At first thought there would seem to be considerable difficulty in doing this, since the frequency of the currents in the secondary is a variable quantity depending upon the slip, and is different from that of the currents in the primary. Nevertheless, this is not difficult to do. By adding a commutator to the secondary and properly placing brushes upon this, the counter-electromotive force may be suitably introduced. The most convenient way of doing this is to connect the brushes to the secondary of a suitable transformer, the primary of which is connected to the power circuit. By using any of the well-known types of regulating transformer, this counter-electromotive force may be varied in amount and in direction. If it opposes the flow of current in the secondary, the speed of the motor will be correspondingly reduced. If, on the other hand, this elecromotive force assists the flow of current the motor may be run above synchronism. In this method, the power which would be dissipated as heat in the rheostatic control is pumped back into the circuit, so that the efficiency of the system is lowered only by the transformer losses.

This arrangement is applicable with either the primary or the secondary as the revolving part. In addition to the speed regulation secured, this system enables one to compensate for the phase displacement of the primary current by the method described by Heyland and others. This is accomplished by shifting the position of the brushes on the commutator. One of the difficulties presented by this system is that of overcoming sparking, but doubtless this can be done.

It is worthy of note that the latest developments of the induction motor, namely, those of improving the power factor and securing variable speed, have been secured by adding a commutator. The absence of the commutator on induction motors has heretofore been urged as one of the chief advantages of this type of motor.

Boiler rivets should be carefully examined, according to a report of the Mutual Boiler Insurance Company, by the following cold tests : Driving them down on an anvil with the head in a die, by nicking and bending back on themselves without developing serious cracks In tests made by the company, steel rivets stood up well as a rule, but iron rivets did not and one brand of steel rivets proved very poor.

ALUMINUM AS A CONDUCTOR.

Cleveland, Ohio, March 13th, 1903.

Editor Electrical News:

Dear Sir:—I was very much interested in a clipping bearing on the subject of aluminum sent to me marked from the "January number of the Canadian Electrical News."

Your correspondent states at the outset that while it was thought some time ago aluminum would be largely used as an electrical conductor, expierience has demonstrated that it is not held in favor and that it has not been adopted to any extent for the purpose mentioned. It seems to the writer that if your correspondent had taken sufficient interest in the subject in regard to which he put himself on paper to ascertain some facts the opinions which he now entertains would be materially altered.

Without going into an exhaustive digest covering the article I would state:—

First: Relative to the cross section and weight of aluminum as respects copper, that for equal conductivity, assuming aluminum 60 to 62 and copper 97 to 98 in the Mattheissen Standard Scale, the cross section of aluminum is 150, copper 100. Your correspondent has evidently calculated that the area of cross section of wires and their diameters bear the same relation to each other, which it is apparent is a slight mathematical error. Correctly calculated an aluminum wire having 1.59 cross section of copper will have a diameter only 1.26 of that of the copper, i.e.: 159 : 100 :: 126 :: 100.

The weight of aluminum having equal conductivity is 47.50 per cent. of that of copper. This arises from the fact that the specific gravity of copper is 8.93 and aluminum 2.68. The following proportion, therefore, gives the result above quoted, taking into consideration that the volume of aluminum is 1.59 times the volume of the copper:—

8.93 x 100 : 268 x 159 :: 100 : x

the solving for, x which is the aluminum weight when the copper weight is 100, we get x=47.5. In other words for equal conductivity on the basis of the foregoing data, 47.50 pounds of aluminum would be required to replace 100 pounds of copper.

Second: Your correspondent states that for small wires an alloy of 1 to 2 per cent. is used to produce strength. This is incorrect, as all wire for electrical conductor work as at present manufactured is of the same quality and is "pure aluminum." The breaking load of aluminum for equal conductivity with copper is as great, if not greater than copper.

Third: In connection with the matter of joints it is stated that aluminum cannot be soldered and what is known as the MacIntyre joint is used. Aluminum soldered joints are in successful service, but for greater strength of the joints, what is designated as a three piece compression joint is recommended for use where large wires are used, for the reason that greater strength and higher electrical efficiency is obtained with a joint of this character than with a soldered joint. A good mechanical or compression joint is in the opinion of some well informed engineers superior to any soldered joint. The reason is obvious, the strength of the former being greater than the latter.

Fourth: Your correspondent states that results are not obtainable respecting the varying climatic effects on aluminum on account of aluminum being installed practically exclusively in the state of California; also that the action of the salt atmosphere has an injurious effect upon the metal. A portion of the above statement is in itself contradictory, because if aluminum was deteriorated by the salt air it would not be used in California or on the Pacific Coast. That aluminum is not injured by salt air action where it is installed on the Pacific Coast in close proximity to the salt water is demonstrated by the fact that millions of pounds have been in successful service for several years and those companies using it for the longest periods continue to purchase it in large quantities, the claim being made in some instances that it is superior to copper.

Relative to the absence of data outside of California, your correspondent is very much in the dark and is not informed. Aluminum is used in large quantities in the New England states, New York state, the middle states, the west and the far west for high tension and feeder railway work and for electric lighting purposes. Some of the largest syndicates and individual corporations in the territories mentioned have used aluminum conductors for a long time and continue to purchase it. While California purchases large quantities of aluminum wire and cables, other territories in the east and west purchase and use it in larger quantities and in those different localities data has been obtained under varying and trying conditions which has been most favorable to aluminum. A particular instance near enough and sufficiently prominent is the last transmission line of the Niagara Falls Power Company from Niagara Falls to Buffalo, consisting of three 500,000 c.m. aluminum cables and which should have been easily within the knowledge of your correspondent if he had really been ordinarily well informed in regard to what has been done in the transmission field and to have prevented his making one of the statements in the article alluded to. Another instance of which he should have been presumably aware is the line of the Shawinigan Falls Power Company from Shawinigan Falls to Montreal, which is entirely constructed of aluminum and will contain quarter of a million pounds of it.

It may be of interest to state that in Eastern New York during the recent extreme cold weather which prevailed about two months ago, in an aluminum high tension transmission line covering a large quantity of wire there was but one break in the system, while on a copper transmission line adjoining of equal conductivity and about an equal quantity of wire there were eight breaks. The showing in favor of aluminum is evident and is most satisfactory. Another instance in a different territory may be cited: A transmission company operating in Colorado, Utah and Montana has over 2,000 miles of aluminum wire in service, the circuits passing through the valleys and over the snow-clad mountains, where it is subjected to the extreme hot and cold temperatures. This company has had aluminum in service for a number of years and still continues to purchase it in large quantities.

Yours truly,

J. A. Rutherford.

ELECTRICALLY CONTROLLED WATER WHEEL GOVERNORS.

Montreal, March 23, 1903.

Editor Canadian Electrical News:

Dear Sir:—The writer noticed in the columns of your March issue the question on electrically controlled water wheel governors.

The Lachine Rapids Hydraulic & Land Company, of Montreal, use in their 12,000 h.p. water power plant a device on their Lombard water wheel governors by which the latter can be electrically controlled from the operating table. This very simple device consists of two solenoids, each of which actuates a ratchet wheel on the spindle of the governor. By operating either of the two solenoids the gates can be opened or closed. Each ratchet wheel has a large number of teeth, so that each time the circuit of the solenoid is closed, only a very small movement of the spindle takes place and consequently a very close adjustment of the speed is possible. It has been found possible to synchronize machines in one-tenth of the time previously required without this device. The device was invented and designed by R. S. Kelsch, general superintendent of the Lachine Rapids Hydraulic & Land Company. Mr. Kelsch also invented, a number of years ago, the motor control device, which your paper mentions, and communicated same to the Lombard Water Wheel Governor Company. In the design of the Lachine Rapids plant, Mr. Kelsch abandoned the idea of the motor control device on the ground that it gave the switchboard attendant too much latitude over the governor.

With reference to the subject of double busbar arrangement mentioned in the same issue by "Reader," I would draw "Reader's" attention to an article on the Lachine Rapids plants in the Canadian Engineer of June, 1901, which particularly describes the busbar arrangements at the power house and sub-station. It is always advisable for a large company, and even for small companies, to have a subdividable double busbar arrangement for its sub-station distribution busbars. The increase in expense over a single busbar arrangement is insignificant compared with the greater safety and better service obtainable thereby. For the transmission of the power to the sub-station, however, a double busbar arrangement is not absolutely necessary. Indeed, the modern practice nowadays is to simplify the power house switching devices as much as possible, and to do away with the double busbars. A single busbar equipment subdivided into three or four sections, tied together or seperated by switches operated by hand and automatically by overload devices, offers sufficient flexibility and all the safety desired. In designing the power house switchboards on this principle, Mr. Kelsch had in view the possibility of tieing the whole system together, or in the event of an accident to any portion of the system, it can be quickly separated from the rest of the system until repairs are completed. The arrangement of puttting the busbars in sections permits during light loads, or Sunday, etc., any portion of the plant to be made dead throughout, permitting any slight repairs that may be necessary and a general and thorough cleaning up of the busbars, marble, etc., without the slightest chance of injury to an emyloyee.

In the case of a double set of busbars, it is usually found necessary to have them comparatively close together, which does not make the system quite so safe and convenient. In the sub-station distribution system double busbars are essential, as it is frequently desired to have two ranges of voltages, one for the heavily loaded, the other for the lightly loaded feeders.

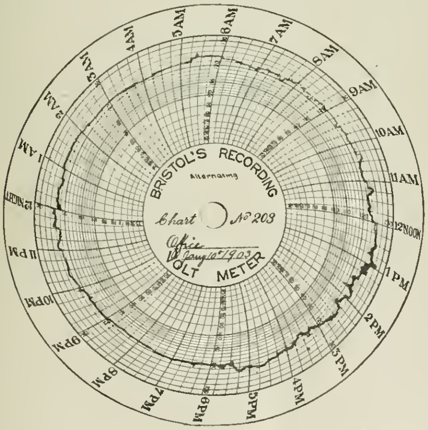
Yours truly,
CHARLES BRANDEIS.

POWER TRANSMISSION AND DISTRIBUTION IN UTAH.

For about three years the Utah Light and Power Company has been running three water power stations and two steam stations all in parallel, on its general distribution system. This has been done without any particular complications, and, as has been proven, with very great advantage in the economizing of the water available in the mountain streams. It is especially interesting, considering that the three water power stations generate and transmit at different voltages.

The Upper Cottonwood Station is equipped with General Electric apparatus, which generates and transmits 16 miles, three phase at 12,000 volts. The Lower Cottonwood Station, equipped with Westinghouse apparatus, generates two phase and transmits 14 miles, three phase at 14,000 volts. The Pioneer Station, situated 37 miles north, in Ogden Canyon, has General Electric machinery and transmits three phase at 16,000 volts. The two steam plants generate at 2,300 volts and feed into the general distribution system in Salt Lake.

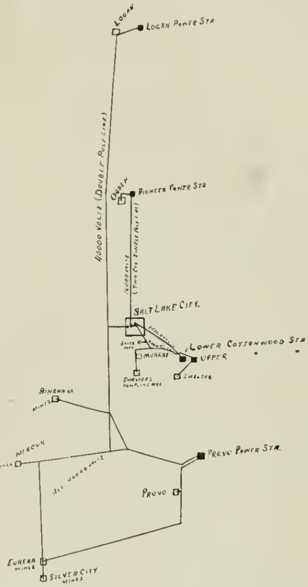
On December 30th, to this already large system, with its six stepdown stations in the valley and in Salt Lake, connection was made from the Telluride Power Company's 40,000 volt system. This company has a duplicate pole line connecting Logan Power Station, 85 miles north of Salt Lake, with Prova Station, 45 miles south. Taps are taken off each of these lines at Salt Lake and the paralleling was done on the low tension side. From the first time this latter system was synchronized with other stations and switches thrown in, no trouble has arisen; the regulation is very materially improved for all.



VOLTAGE CHART UTAH LIGHT & POWER COMPANY.

On this combined system there are operated rotary converters supplying the street railway system, large induction and synchronous motors operating 550 volt railway generators, Portland cement mills, brick works, ore sampling works and various other plants scattered throughout the valley and in Salt Lake. On the Telluride Company's system are large induction motor mine hoists, mills, etc., in a half dozen of the largest mining camps in the state.

Since the general lighting systems for Salt Lake and Ogden, besides several smaller towns, are fed off this same large network, it speaks well for the regulation obtained, when it is considered the class of variable motor service and railway load carried. The voltage chart shown herewith is taken off the general lighting system in Salt Lake. The chief advantage in thus running all in multiple is the "momentum" that is back of all the severe changeable loads, motors starting, etc., so that no effect on the general system is noticeable.



POWER STATIONS AND TRANSMISSION LINES OF THE UTAH LIGHT & POWER COMPANY.

Within four weeks there will be started an additional steam three-phase unit of 750 k. w. capacity, and by October next another three-phase direct connected unit of 1000 k. w. capacity will be added. To the present rotary station for carrying the railway load will be added in September a 750 k.w. synchronous motor generator set.

By June next a sixth water power station, located on Bear river, 80 miles north of Salt Lake, will be completed and will be run in parallel with above systems. In this station two 750 k.w. Westinghouse units are being installed, and the transmission will be at 28,000 volts. By that time it it expected that the Cottonwood stations and the Pioneer station in Ogden Canyon will be changed over to transmit also at 28,000 volts, thus simplifying greatly the connections at the distribution end, for working in parallel.

The combined capacity of above stations, both steam and water, will reach 17,000 h.p.

The accompanying sketch shows the various transmission lines mentioned above, also location of power stations.

O. A. HONNOLD,
Division Engineer Utah Light & Power Company.

CANADIAN

Electrical News

AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.

BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official pape of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.

1ST VICE-PRESIDENT:
EDWARD SLADE, General Superintendent Jacques Cartier Light & Power Co., Quebec.

2ND VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A. B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
ORMOND HIGMAN, Chief of Electrical Inspection Department, Ottawa.
ED. A. EVANS, Manager Quebec Railway, Light & Power Co., Quebec, Que
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
A. SANGSTER, Manager Electric Light & Power Co., Sherbrooke, Que.
A. A. WRIGHT, M. P., President Electric Light & Power Co., Renfrew Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON,	Toronto.
Vice-President, CHAS. MOSELEY,	Toronto.
Treasurer, A. M. WICKENS,	Toronto.
Registrar, J. G. BAIN,	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN,	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER	Baden, Ont.
Vice-President, H. E. TERRY,	Toronto, Ont.
Secretary, W. INGLIS,	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont.
Conductor, J. STRUTHERS,	Sarnia, Ont.
Door Keeper N. BEAN,	Waterloo, Ont

Alternator Frames.

This continent usually takes unto itself the credit of being considered the home of the latest developments in the electrical arts, but European engineers are now exploiting, and with apparent success, an idea which so far has found but little favor on this side of the Atlantic. We refer to the use of strutted frames for large direct driven alternators, that is, instead of having the iron of the stationary part of the machine held in place and supported by the cast iron box frame which is common practice with us to-day, they are experimenting with a steel structure, built up very similarly to the latticed girder work used in towers and bridges. This it is claimed gives a machine of equal rigidity and of materially less cost, the saving in material being very marked, besides which the plant cost would be still further reduced, as the lesser weight means a corresponding reduction in the outlays for freight and installation.

Amalgamation of Electric Companies.

The announcement is now made that the Montreal Light, Heat & Power Company has succeeded in making arrangements for the control of the Lachine Rapids Hydraulic & Land Company. This will perhaps be not altogether welcome news to the consumers, who have hitherto looked upon the somewhat severe competition which has obtained in Montreal as a guarantee of a good service at a reasonable cost. We have every confidence, however, that the new organization will endeavor to treat its patrons, both present and prospective, in the best possible manner, and to provide an efficient service at a reasonable cost. It would almost seem reasonable that the rates might be reduced at no very distant date, as the operating expenses and fixed charges of the combination ought to be less than the sum of those incurred by the two companies now operating. It is reported that the price paid by the Light, Heat & Power Company is $190 per share, the Lachine Company being capitalized at $2,000,000. The price asked some few months ago, when the subject of amalgamation was being actively discussed, was $250 per share.

The Possibilities of Electricity.

MR. Charles P. Steinmetz, in a recent paper given by him at Schenectady, N.Y., on the future possibilities of electricity, made some interesting remarks regarding his ideas of what it was likely to come to. Anent wireless telegraphy he seemed to think that it had a large future in the conducting of wars, as neither combatant would be able to destroy the enemy's communication by cutting wires. Further, it would probably be largely used in exploration work the world over, which would prevent the complete isolation which has hitherto been an accompaniment of all Arctic expeditions. Regarding the telephone it was stated to be yet in its infancy, trans-Atlantic communication being a question of but a comparatively short time. The complete superseding of the steam locomotive by the electric is, in his opinion, a very far distant change, commercial reasons rendering it of doubtful practibility. Mr. Steinmetz is an active exponent of the mercury vapor lamp, having developed a system which is in operation in his home at Schenectady, and for which he predicts a large field within but a comparatively short time.

Storage Batteries.

The past month has seen the lapsing of one of the most important and broadest of the many patents affecting the electrical industry, namely, that issued to Charles F. Brush in 1886 and covering the construction of storage battery plates. It has been freely predicted that once this patent had expired there would be a substantial decrease in the price of this apparatus, and that its field of application would be correspondingly broadened, but it is practically impossible to prophesy truly as to what the future will bring out. Any interest which is protected by broad and fundamental patents has a most excellent opportunity, during the life of those patents, to fortify itself against the free competition which will undoubtedly arise as soon as the time limit has expired, and but few organizations neglect to avail themselves of the chance. In view of this it may very likely be found that while various companies may be free to manufacture the actual batteries, but few will be able to place their product into commercial service, owing to the subsidiary patents which cover various necessary accessories, such as boosters and the switchboard equipment.

Cleanliness in Central Stations.

It is to-day a well known and universally acknowledged fact that the reliability and longevity of any piece of machinery are very much affected by the care taken to keep it in good condition. Especially is this true of electrical apparatus, in much of which the length of life is determined not so much by the actual amount of time it is in operation and the loads it is called upon to carry as by the state of cleanliness in which it is kept. "Show me his friends and I will describe you the man," is often heard in our midst to-day. "Let me see the fire hole and the dynamo room, and I will tell you whether or no he is a good man, a man worth having, a man fit to be in charge of your plant," is but another rendering of the same principle. When one goes into a power house and is confronted with dirt and dust, creeping oil and greasy clothes, untidy furniture and lamps half dimmed with the multitudinous deposits of many months, it is but small wonder that the man in charge is instantly ranked in the mind of an observant visitor or inspector as but a poor specimen. If the outside appearance of the apparatus and room is so neglected, one argues, perhaps unconsciously, it seems but reasonable to suppose that insidious dirt is hard at work in all the hidden corners and unseen spaces, the inevitable fruit of which will be frequent shut-downs and heavy repair bills, and so it is that a dirty and untidy engine and boiler room instantly militate against the engineer. So much for the view from the owner's standpoint. Let us survey it from that of the employee. How few and far between are the managers who will entertain suggestions for the purchasing of a decent set of repair tools and a place to keep them in, a liberal supply of brooms and waste and now and again a can of paint and varnish. Yet without them the incentive to keep the place in good condition is soon smoothered. How seldom does one find a station equipped with a good supply of spare parts properly stored for emergency use, even though their purchase had time and again been recommended by the engineer. How many of our plants are equipped with a compressed air system, notwithstanding that it has no equal as a quick and most thorough method of cleaning machinery, electrical apparatus particularly. To seem the matter up, employers should spend more money, and we refer more particularly to what are called small plants, on a liberal equipment of tools and cleaning utensils ; employees should devote more time and attention than is usually given to the repairing and cleaning of the power house and the apparatus it contains. The money and the effort will both prove good investments, for without them no plant can possibly give the results which it otherwise is quite capable of producing.

The C. E. A. Convention.

As our readers are perhaps aware, the annual convention of the Canadian Electrical Association is to be held in Toronto on June 10th, 11th and 12th next, of which full particulars will appear in a later issue. In the meantime we desire to urge upon all those connected with electrical industries, more especially the commercial men, that they should make a special effort to be present. As we have previously pointed out in these columns, no man who is debarred from even occaionally meeting his co-laborers and dicussing with them their mutual difficulties, experiences and methods can possibly produce results equal to those of the man who has availed himself of the opportunities of public discussion which are afforded by all conventions, and we would therefore say again to all our Canadian operating friends : Send along those of your staff to whom you look for results in the shape of dividends ; it will be money well spent. We are aware, in saying this, that it may appear to be a somewhat sordid motive to urge, but the convention is really not intended to be a holiday for those attending, but rather an opportunity to benefit by the experience of men whose experience has run in lines different to our own. There are many electrical plants in the convention city possessing features of great interest to the members of the Association, the various officials of which will doubtless be glad to extend an invitation of inspection to the visitors. The city itself is one of the finest and prettiest on the whole continent, and the committee in charge of the convention arrangements are thoroughly equal to the task of providing a most entertaining programme of papers and discussions which will be of great benefit to those who hear and participate in them. May we again urge every manager and superintendent, especially of operating companies, to make special efforts to be present, and further to take part in the discussions. There are yet a great many questions affecting the industry which should be taken up vigorously by the Association both for the benefit of the individual members and the country at large.

THE "LONDON STANDARD LAMP."

Owners and operators of incandescent electric lighting plants should be interested in learning something about the merits of the above lamp, an illustration of which appears in the advertisement in this paper of the manufacturers, Messrs. Phillips & Company, of Edinhoven, Holland.

It is claimed for this lamp that it gives a maximum of light at minimum cost. The company make both high and low voltage lamps adapted to a variety of purposes, and would be pleased to send prices with full particulars of their goods to any of our readers who may write for same, mentioning their advertisement in the ELECTRICAL NEWS.

THE UNIVERSITY OF NEW BRUNSWICK AND ITS ENGINEERING DEPARTMENT.

The University of New Brunswick is located in Fredericton, the capital of the province of New Brunswick. The city is situated on a large level piece of land around which flows the St. John river in the form of a large bow. Back of the city rise the hills of the valley and part way up these hills is located the University.

Entering the University grounds, a long winding driveway through a grove of maple and beech trees leads up to the buildings, from which a most magnificent view of the city, of the St. John river, and of the surrounding country is obtained.

The University is supported by the Provincial Government and by the income derived from grants made by the Crown, as well as by the students' fees. It was first founded in 1800 by a Provincial Charter and called the College of New Brunswick. In 1828 a Royal Charter was granted by the Crown incorporating the college by name of Kings College. In 1859 an act establishing the University of New Brunswick and transferring to it all the lands, rights, endowment and other property of Kings College was passed by the Legislature of New Brunswick.

At present the University is governed by a body styled the Senate, the president of the Senate being the Chief Superintendent of Education. The Chancellor of the University, who directly manages the University for the Senate, is also a member of this body. The other members of the Senate are either appointed by the Government or elected by the Alumni Society and Teachers' Institute.

The University has four distinct courses and grants three degrees, namely, that of B.A., for the Arts course; that of B.Sc. for the Science course; and that of B.A.E. for either the Civil or the Electrical Engineering courses.

The Engineering Department, which gives a degree in either Civil or Electrical Engineering, has been established only a short time, but has attracted considerable attention due to the rapid progress it has made and the thorough and efficient courses which it gives.

In May, 1900, the University celebrated its one-hundredth anniversary by laying the corner stone for its Engineering Building, and this was ready for occupancy in May, 1901. The electrical, cement testing, steel, iron, wood, brick and stone testing laboratories, workshop and janitor's room are located in the basement of this building. The basement also provides room for the engine, boiler, hot water heater, and storage battery, in addition to the dynamo, motor, testing machines, etc., used in the laboratories.

On the first floor are the Physical and Chemical laboratories, the Physical and Chemical lecture rooms, the Chemical store room and the Bursar's office. On the second floor are the drafting room, instrument room and engineering museum, a lecture room and library. The entire building is heated by hot water and lighted by electricity.

University of New Brunswick, Fredericton.

The Engineering students attend lectures in the Arts building as well as in the Engineering building. The Arts building contains the Mathematical, English, French, Classical, Natural Science and Philosoplical lecture rooms, the Natural Scienceand Philosophical laboratories, the main museum, library, reading rooms, Y. M. C. A., rooms, residency rooms, Chancellors' and Stewards' apartments.

The observatory contains an achromatic telescope, equatorially mounted, meridian transit and sidereal chronometers. Observations are taken for the Meteorological Survey of Canada.

The course in Civil Engineering extends over four years and is not narrowed down to any special branch, but is designed to fit the young graduate to take a position in any of the numerous special branches of Civil

Engineering by giving him a thorough training in the principles common to all.

The course in Electrical Engineering also extends over four years and is designed to furnish an extended training for students who desire to become specialists in the field of electrical science, with its numerous applications in modern industries. The leading subjects constituting the course are Theoretical and Practical Electricity, Physics, and those branches of Mechanical Engineering which are especially adapted to the wants of the electrical engineer. The theory of electricity is thoroughly taught and is supplemented by an extensive laboratory practice. The University has been granted the use of the dynamos, motors, lines, etc., of the Fredericton Electric Lighting Company, and each year a number of practical tests are made to enable the student to become familiar with many of the appliances used in the generation and distribution of electricity. The Canadian General Electric Company, of Toronto, has presented the University with a 3-kilowatt compound dynamo and rheostat, a 3-kilowatt shunt motor, two switches, a voltmeter, and an ammeter, while the University has purchased a storage battery and the apparatus necessary for wireless telegraphy, and is granted the use of an X ray outfit.

Steam Engineering is taken up in the third year. The theory of heat is first thoroughly studied, so that the student may be prefectly familiar with the laws and formulæ governing the production and expansion of steam. The various kinds of boilers and the methods of determining the grate surface, heating surface and chimney area required for a boiler of any horse-power are then discussed. After this the theory of the steam engine itself is taken up and experiments are made with the engine at the University to determine its indicated horse-power.

In the first two years of the Electrical Engineering course the student is taught English, French or German, Mathematics, Botany, Drawing, Surveying, Logic and Physics, and must prepare a thesis during the summer vacation de scriptive of an engineering work or structure. In the third and fourth years the course is as follows :

THIRD YEAR.

1, Calculus ; 2, Applied Mechanics ; 3, Physics ; 4, Theory of Steam Engine ; 5, Lectures in Elements of Electricity and Magnetism, with particular references to Thompson's "Lessons in Electricity and Magnetism." 6, Lectures on Electrotechnics : Primary and Secondary Batteries, the Telephone and the Telegraph; 7, Electrical Measurements : Carhart and Patterson's Laboratory Manual is used ; 8, Chemistry.

FOURTH YEAR.

1, Graphic Statics; 2, Hydraulics; 3, Theory of Electricity : Mathematical Theory of Electricity and Magnetism (J. J. Thompson), Theory of Electricity (Cumming), and Theory of Electricity (Gray), are recommended for reading in connection with these Lectures ; 4, Lectures on Electrotechnics : Systems of Distribution, Incandescent Lamps and their Manufacture, Arc Lights and their Regulation, Electrolysis ; 5, Dynamo-Electric Machinery: Dynamo-Electric Machinery (S. P. Thompson) and Dynamo-Electric Machinery (Urquhart) are recommended for reading in connection with these Lectures ; 6, Laboratory work, including Calibration of Instruments, Dynamo Tests, etc. ; 7, Thesis. A Thesis on some subject within the field of Electrical Engineering must be submitted to the Professor in charge at least two weeks prior to final examinations. Diplomas in Electrical Engineering will be awarded to those candidates only who present acceptable Theses.

There are at present forty-one engineering students at the University. The students of the first, second and third years are required to attend a summer camp

Engineering Building, University of New Brunswick, Fredericton.

for the purpose of making surveys for a short line of railway. This survey is mapped and traced by students of the fourth year.

The Engineering Society of the University of New Brunswick is open to students, practising engineers or those interested in Engineering. The Lieutenant-Governor of the province is honorary-president and many prominent engineers of the Maritime Provinces are enrolled as members. Meetings are held in October, November, January, February, March and April, at which papers are read and discussed by the members. This society has proved itself to be a great benefit to the engineering students.

The members of the Engineering Faculty and those of the Arts Faculty who assist in engineering subjects are given below :—Dean of the Engineering School, Professor of Civil Engineering and Lecturer in Chemistry, Ernest Brydone-Jack, B.A., C.E., Associate Member American Society of Civil Engineers, Member Society for Promotion of Engineering Education; Arthur Melville Scott, B.A., Ph.D., Prof. of Physics and Electrical Engineering and Lecturer in German ; Thomas Harrison, M.A., LL.D., Chancellor of the Uuiversity and Professor of Mathematics ; Loring W. Bailey, Ph.D., LL.D., F.R.S.C., Professor of Natural History and Geology ; William Hall Clawson, M. A., Professsor of English and French ; J. Woodbridge Riley, Ph. D., Professor of Philsophy and Political Science ; Ralph St. John Freeze, Student-Assistant Chemical Laboratory.

PROF. E. BRYDONE-JACK.

Professor Brydone-Jack was appointed Dean of the Engineering Faculty in May, 1902, retaining at the same time the professorship of Civil Engineering to which he had been called the previous year. He has had a large and varied experience in practical work, having worked on or had charge of detail designs for many well-known engineering structures, such as the viaduct for extension of Riverside Drive, New York, part of the Boston subway, part of the Southern Union Station, Boston, and the Rankin bridge having the heaviest 500 foot span then built. He was also engaged in railroad work on the St. John Valley and Riviere du Loup Railway surveys, on the Harvey-Moncton short line surveys, with the Delaware & Hudson Canal Company, and with the Buffalo, Rochester & Pittsburgh Railway Company. He was engineer in charge of one of the branch offices of the Keystone Bridge Works, then a part of the Carnegie Steel Company, for one year, and before taking the chair of Civil Engineering at the University was engineer in charge of the drafting department of the Fort Pitt Bridge Works. At present he also holds the position of City Engineer for Fredricton, N. B. He is thus eminently qualified to give a thorough and practical course in Civil Engineering and to direct the work of the Engineering Department.

Prof. E. Brydone-Jack, B.A.
Dean of the Engineering Faculty and Professor of Civil Engineering, University of New Brunswick.

Dr. A. M. Scott, B. A.
Professor of Electrical Engineering and Lecturer in German, University of New Brunswick.

Professor Brydone-Jack was born in Fredricton, N.B., in 1871, his father having been President of the University from 1861 to 1885. He obtained his High school education under the well known Dr. Parkin (who is now acting for the trustees of the Cecil Rhodes scholarships), winning the prizes for the best general standing in the different years, as well as winning the Douglas Medal for Classics and the Mathematical Prize. In September, 1887, he entered the University of New Brunswick, matriculating at the head of his class and taking the York County Scholarship. After taking the full four years' arts course he graduated at the head of his class in 1891 with degree of B.A. He then entered the Rensselaer Polytechnic Institute of Troy, N. Y., taking the full four years course in three years, graduating with degree of C.E. in 1894, also winning the prize given in the junior year for the best summer thesis of the class. From 1894 to 1901 he was engaged in the active practice of his profession.

Professor Brydone-Jack is a member of the Society for the Promotion of Engineering Education, as well as an Associate Member of the American Society of Civil Engineers. He also organized last year the Engineering Society of the University of New Brunswick, the membership of which includes many of the prominent engineers of the Maritime Provinces and vicinity, as well as the students of the University.

DR. A. M. SCOTT.

A. Melville Scott, B.A. (Toronto '96), Ph.D. (Gottingen '98), Professor of Physics and Electrical Engineering, was appointed to his present position in 1899, after having spent the preceding year as instructor in the Department of Physics at the University of Toronto.

He is a native of Ontario, served his apprenticeship at teaching in the public schools of that province, and, attending the Normal School at Toronto, succeeded in winning the Gold Medal in June, 1890. After two years spent at the Parkdale Collegiate Institute he entered the University, taking the Honor Course in Mathematics and Physics, in which he obtained a foremost standing throughout, at the same time reading largely in English and other modern languages. In addition to scholarships and prizes during the preceding years, the McDonald Gold Medal for Mathematics and Physics, and the Aberdeen Gold Medal for General Proficiency from Victoria College, fell to his lot at graduation, also in addition the 1851 Exhibition Science Scholarship was awarded him by the University for research work carried on during the fourth year. The two years following graduation were spent in Germany in further study and research at the University of Gottingen ; during this time many opportunities were afforded him of visiting the various parts of Europe, centres of commerce and of manufacturing industries, as well as seats of learning.

With a wide range of experience and a many-sided view of life, Dr. Scott is now devoting his energy and ability as a teacher to the improving of the facilities for technical education in the Maritime Provinces, especially New Brunswick, as furnished by the Engineering Department of the University of New Brunswick. Under his direction the incipient course in Electrical Engineering is becoming firmly established, and bids fair to be as popular as the older course in Civil Engineering.

SOME ELECTRICAL FEATURES OF THE UNIVERSITY CONVERSAZIONE.

By C. Chant, Ph. D.

At the recent Toronto University College Conversazione, held on the evening of March 19th, two of the electrical exhibits were of special interest. These were the demonstrations of wireless telegraphy and of the Simon "singing arc lamp."

In the former, two systems were shown. One of these was that devised by Prof. Braun and the firm of Siemens & Halske. The apparatus exhibited in operation is suited only for short distances (100 yards being the greatest distance to which signals have so far been sent,) but the instruments are precisely of the pattern used in long distance work. They were purchased by the University at the request of the writer, for use in an investigation now being made into some of the phenomena of wireless telegraphy. The little transmitter with its eight miniature Leyden jars and its small transformer, actuated by a small induction coil fed by two accumulators, was placed at one corner of a large hall while the receiver was at the oppossite corner, about thirty yards away. Connected with the latter was a Morse register, kindly loaned by A. B. Smith, Esq., of the G. N. W. Telegraph Company, and signals were freely received either by the ringing of the call-bell or by markings on the paper tape. The antennae were but 2½ metres long, the wave-length used being ten metres.

But the most convincing exhibition was with the De Forest system. When communicated with, Mr. Thomson, the manager of the De Forest Company, and Dr. de Forest gladly agreed to assist in the exhibition, and Messrs. H. E. Athearn and J. A. Wallace freely offered to be present and send and receive actual messages.

The regular alternating-current transmitter used in this system could not be conveniently installed, so one with a medium-sized induction coil was improvised. The antenna, which was nine metres long, was suspended from the ceiling by a cord, the ground connection being to a steam-heating radiator near by. This transmitter was placed on the same table as the little Braun sender. About 110 feet away, and separated by three solid brick walls, the little "dinky" responder—small enough to be put in a coat pocket—was placed on a table at which sat the receiving operator with the head-telephone on. The effect on the responder was so strong when one side of it was joined to a radiator that no antenna was used.

For two hours the visitors wrote messages (on the ordinary blanks) and handed them in at the sending end, where they were promptly despatched at the usual telegraphic speed ; and those to whom they were addressed, on calling at the receiving office, were delighted to have their "aerograms" handed them, sent without a mistake. Indeed, to test the operators, Prof. Masson, of Victoria College, sent a message in French, and it reached the proper person without a slip. During the evening nearly fifty messages were sent and received, constituting an excellent demonstration of the reality of the new system.

About ten feet farther away from the sending station, on the other side of a fourth brick wall, the writer had arranged another receiving station. At this place the responder was simply joined in series with two dry cells and an ordinary telephone receiver ; while an antenna ten metres long, suspended from the ceiling, was joined to one side of the responder, the other side being connected to a sheet of tin about 2x3 feet lying on the floor. No connection at all was made to earth. The signals here were perfectly clear, and astonishment was expressed at the wonderful results with such simple means. The De Forest responder is certainly an extraordinarily sensitive and effective instrument.

Amongst those who received messages or sent them may be mentioned : Mrs. Moss, wife of the Vice-Chancellor of the University ; Mrs. Harcourt, wife of the Minister of Education ; Mrs. A. B. Macallum ; Prof. Baker ; Prof. DeLury ; Registrar Brebner ; and many others.

Some interesting observations were made when testing the experimental arrangements on the previous evening. When the large transmitter (with 9-metre antenna) was in action, the Braun receiver (with 2 1/2 metre antenna), 30 feet away, was unaffected ; but when this antenna was made ten metres long, and especially when earthed to a radiator, the signals were pretty freely received. Also, when the Braun sender, with 2 1/2 metre antenna and no earth connection at all, was in operation the messages were read with the De Forest responder at a distance of 120 feet, with four solid walls intervening, one side of the responder being joined to a radiator but no antenna being used.

The "singing arc" was arranged under the direction of Prof. Rosebrugh, of the Faculty of Applied Science. A phonograph was in one room, while the arc lamp was in another room across a hallway and about fifty feet distant. Tunes uttered by the former in the neighborhood of a carbon microphone were repeated by the brightly-shining lamp, so as to be heard by all in the room. The lamp was exhibited by Mr. M. V. Sauer, of the Department of Electrical Engineering.

AMALGAMATION OF ELECTRIC COMPANIES IN MONTREAL.

On March 17th negotiations were concluded by which the Lachine Rapids Hydraulic & Land Company, of Montreal, was absorbed by the Montreal Light, Heat & Power Company. It is understood that the price paid for the Lachine Company's stock was $190 per share or a total of $3,800,000. The Light, Heat & Power Company have thus acquired the Lachine Rapids Company, the Citizens' Power Company, the Standard Light & Power Company, and a lease of the Shawinigan Water & Power Companys' plant in Montreal.

The public have been assured in a degree that prices for electric current will not be advanced by the offer of the company to close contracts for both gas and electricity at current rates for a term of one, three, five, or ten years.

Mr. Rodolphe Forget, second vice-president of the company, is authority for the statement that all the power generated by the different plants will be centered at the Queen street station, which was built to take care of 100,000 horse power. He points out that before the end of this year the company will be recieving over 80,000 horse power, i.e., 23,800 h.p. from Chambly, 6,000 h. p. from Ste. Therese, 12,000 h. p. from Lachine, 8,000 h. p. from Shawinigan, and 30,000 h. p. from Soulanges Canal. Friends of the company control also the St. Louis Power Company's proposition opposite Heron Island, which will be developed as circumstances require. Mr. Forget expresses the opinion that out of the 80,000 horse power of steam production now used in Montreal, 75 per cent. will be replaced by electricity within the next five years.

It is reported that persons representing the Montreal Light, Heat & Power Company have acquired control of the Jacques Cartier Light & Power Company at Quebec.

QUESTIONS AND ANSWERS

The question submitted by the Hamilton subscriber signing himself "Armature" is not sufficiently clear to enable a reply to be given. If he will explain more fully the points on which he desires information, we shall be glad to answer.

"J. R.": What is the proper locations for alternating current lightning arresters? Are double or single pole the most desirable to use? Are they ever placed on the secondaries?

ANS.—As a general rule arresters are placed at both ends of a line, and also at the ends of any branches. Further than this, it is usual to install a set beside any large machine or group of apparatus, and also, if the line be hilly, it is sometimes found advisable to locate a set on the top of any prominent rise. It is generally considered preferable to put in single pole equipments instead of double pole, as they somewhat lessen the chance of short-circuits occurring if a heavy discharge should damage the arrester, though two single pole equipments will naturally cost somewhat more than one double pole. We do not know of any installations in this country which have arresters on their secondaries, though we believe that they have very occasionally been used on the other side.

"R. M. Smith": Why are induction motors not built for high potentials such as 6,000 and 10,000 volts? We often see synchronous motors operating at those pressures.

ANS.—The greater number of turns per coil which are necessitated by these high voltages, as compared with the more moderate pressure of 500 or 1,000 volts, makes it impossible to build an induction motor which would have a sufficiently high power factor for commercial purposes. This objection does not hold good for those of the synchronous type, whose power factor is controlled by the excitation furnished from the exciter, and which can be made practically unity if the load does not vary too rapidly.

"L. M.": We have a 2000 volt single phase circuit which according to the wattmeter is carrying 105 k.w., and in which the power factor is 90 per cent. What is the current?

ANS.—When the wattmeter registers 105 k.w., the power factor being 90 per cent., it means that this reading is but 90 per cent. of the kilo volt amperes in the circuit, or in other words, that the k.v.a. flowing is $\frac{100}{90} \times 105$. The current is then $\frac{100}{90} \times 105 \div 2000 = 58\frac{1}{3}$ amperes.

"Ned": How would you build a concrete dam 66 ft.x15 ft. high? How much stone is required? How many waste gates would you put in it to control eighty-seven square miles of water? Where would you put them? I want to connect a fifty horse power water wheel under a 13 foot head, what size spout should I use? Is a wooden spout or an iron spout the best? Another 60 h.p. water wheel is to be connected 200 feet from the dam. What size spout should I put in? What company in Canada makes a good water gate? Will cement set in still water? Where can I get some illustrations of dams, or a good practical book on water powers, dams, etc.?

ANS.—We regret that we are unable to answer your various questions, as anything in the shape of a satisfactory reply involves an investigation into drawings, layout, etc., far beyond the scope of this department. We would suggest that you communicate with one of the consulting hydraulic engineers whose cards you will find in this paper.

"Reader": What is the Ward-Leonard or turret system of motor control?

ANS.—The principle used in this system is that of varying the voltage impressed upon the armature of the motor by changing the voltage produced by the generator, instead of inserting rheostats into the motor armature circuit. This latter, if shunt wound, has to be provided with some source of field excitation other than the line which supplies the armature. It will be evident from the above that a generator is needed for each motor, unless two or more of these latter are required to have their speeds varied simultaneously and to the same extent. The system is more particularly for use in those plants where a large motor requires to have its speed varied over a large range and by very fine steps, the economy over rheostatic control being very marked, and the various changes in speed being controllable by the operator to as fine an extent as is desired.

"Dynamo Tender": Can you give me any information as regards a good method of keeping commutators true without turning them? Sandpaper does not seem to do it.

ANS.—You can accomplish a good deal by cutting a good sized block of sandstone to the arc of the commutator, and holding it on while the machine is run at a fair speed similarly as sandpaper is used. This will cut down the high places and give you a good surface if things are not in too bad a condition, though the process is somewhat slow compared to turning. Be sure before you start that the commutator is tight, otherwise you may find yourself as badly off as ever in the course of a couple of weeks, with all your labor lost.

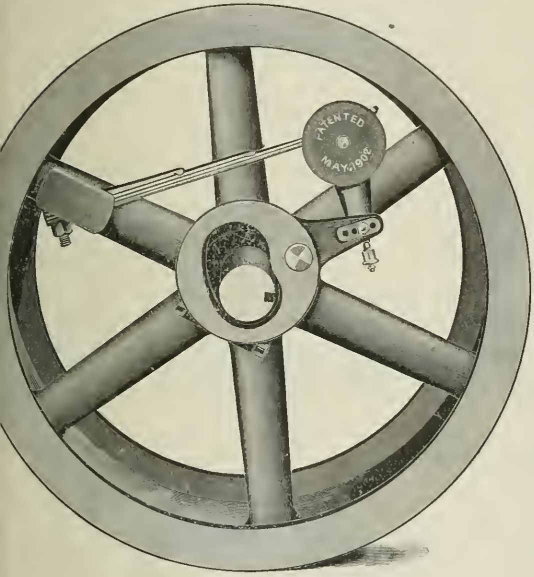
"Montreal Resident": Would you please tell me the meaning of the term "concatenation" when used in connection with induction motors.

ANS.—It is an expression used to designate the connection of two induction motors in series with each other, somewhat alter the style of the series connections used in the control of street railway motors. In this latter case the two machines are connected strictly in series and the same current goes through both, but when using induction motors there is a slight difference, the secondary of the first machine being connected to the primary of the second, and supplying current to it at a frequency just half of that of the supply circuit. The two motors are thus run at about half normal speed, the first because its armature has got a resistance connected into it, namely, the field of the other machine, and the second because the frequency of the current supplied to it is half the normal. The method is practically never used commercially except in polyphase railway work, where it affords an economical method of obtaining low speeds, similarly to the true series parallel system as applied to direct current apparatus.

THE ROBB-ARMSTRONG-SWEET GOVERNOR.

The design of centrifugal governors has occupied the attention of engine designers and builders ever since steam engines have been used, and particularly of late that form of governor which is placed in the fly-wheel of the engine and is attached to, or forms part of, the valve-driving mechanism and arranged to vary the point of cut-off of steam in the cylinder automatically. It has been found especially difficult to get a governor powerful enough to operate the valves and valve gear regularly and, at the same time, to give sufficiently close and quick regulation to meet the very exacting requirements for driving electric generators, particularly for lighting or combined lighting and power service and for parallel operation of alternating current generators. This type of governor has appeared in almost numberless forms, many of them more or less successful, but all lacking absolute perfection either in governing qualities or in mechanical details. In order to prevent disturbance of the governor by reciprocating valves, various friction devices have been used as a part of the governor or in connection with it, such as double eccentrics, dash pots, drag springs, etc., and while these give a certain measure of stability, they prevent quick regulation and are liable to cause the governor to race or hunt.

The governor invented by Professor John E. Sweet was a decided advance over earlier types, having a less number of parts, only one weight and one spring, the governor system in perfect gravity balance in all positions, and great centrifugal power with less friction in the moving parts than previous forms of governor.



Robb-Armstrong-Sweet Governor.

The Rites type of governor forms another step in advance, as it utilizes the inertia of a heavy weight suspended in the fly-wheel to give quick governing. The arrangement of the inertia governor is such that any change of speed causes the fly-wheel and the suspended inertia weight or arm to which the eccentric is attached to change their relative positions, so that the cut-off is changed quickly to meet a sudden change of load. The inertia of this heavy arm also prevents, to a certain extent, disturbance of the governor by the reciprocating motion of the valve. The disadvantages of this form of governor are (1) that the inertia weight and eccentric being all in one piece must be out of gravity balance in order to have centrifugal force, and the governor system not being in balance, is caused to oscillate, especially at slow speeds. (2) The strain due to the centrifugal force and gravity of the heavy inertia arm is carried directly by the suspension pin, which is not easily lubricated; therefore, both from the absence of gravity balance and because of the increased strain and friction, the designer cannot introduce very much centrifugal force, with the result that the regulation is influenced greatly by any variation in the friction of the valve or valve gear, tight or loose packing of the valve rod, change of steam pressure, etc., and if the suspension pin gets dry, as it is liable to do while moving under heavy pressure, the governor is sure to regulate badly. (3) Although inertia tends to overcome friction and cause quick movement, unless the movement is controlled by powerful centrifugal and centripetal forces, the governor will not be stable, and the Rites type of governor cannot have these powerful forces without being correspondingly out of gravity balance, nor without great strain and friction on the suspension pin.

The real controlling power in a governor depends upon the amount of the unbalancing of the centrifugal and centripetal forces, and this may be made sufficient in amount (1) by a great change of speed, or (2) if the centrifugal and centripetal forces are strong, a small change of speed will cause a considerable unbalancing of the forces and a correspondingly quick change of the governor to a new position where the forces are again in balance. If there were absolutely no friction or inertia in the moving parts of the governor, any unbalancing of the forces would cause the governor to move instantly to a new position where the balance would be restored. The more friction there is the slower the mechanism will adjust itself to the new position, and the effect of slow movement is to allow a further change of speed, and that the governor will move too far and then come back, with the result that there will be a constant hunting to find the proper position.

In the Robb-Armstrong-Sweet governor the manufacturers claim that centrifugal weight is carried by the spring directly, so that the heavy strain due to centrifugal force is not brought on the suspension pin, which merely carries the eccentric and is not subject to any strain or friction except that due to the driving of the valve gear. The governor system is in gravity balance in all positions, because the eccentric is made to balance the centrifugal weight, the principle of balancing being the same as that invented by Professor John E. Sweet and employed in the Straight Line engine governor.

The centrifugal weight may be very heavy without bringing undue strain on the spring, because a large part of its centrifugal force is carried by end pull on the flat leaf spring, so that the inertia of the weight is sufficient to prevent disturbance by the reciprocating motion of the valve gear, and the weight is so placed that it also gets the effect of inertia for quick regulation. The result is an extremely simple and powerful governor, in which there is not enough friction to prevent the governor from changing position almost instantly, and no possibility of racing when properly adjusted.

The eccentric being under reversing strains, from driving the valve gear, allows the oil to reach the rubbing surfaces of the suspension pin and bush, so that there is practically no friction or wear. Other important advantages are that by means of a simple adjustment of the link connecting the eccentric and centrifugal weight, the governor may be adjusted to any degree of sensitiveness or close regulation; if desired, the engine may be made to vary only one revolution from no load to full load, and the operating engineer by simple directions may change the speed of an engine at any time.

This governor is the joint invention of Mr. E. J. Armstrong, of New York, and Messrs. D. W. and A. G. Robb, of Nova Scotia, based on Professor Sweet's invention, and is patented in the United States, Canada and European countries.

THE ELECTRIC CLUB OF PITTSBURGH.

The first annual report of the Electric Club of Pittsburg, Pa., is issued in the form of an attractive booklet under date of March 19, 1903, the anniversary of the Club's organization. This pamphlet, of artistic design and illustration, gives the constitution and membership of the Club, the scope, plans, and personnel of the various committees, and an outline of the work accomplished and proposed. A feature of this work which has proven very valuable is the formation of classes for the study of technical subjects under the instruction of various engineers of the Westinghouse Electric & Mfg. Company. These classes, or "sections", constitute "self exciting" engineering societies within the parent body, each section pursuing a separate and definite line of study. As a further aid, there is a well equipped technical library, including the varions electrical and mechanical magazines.

Fogarty Bros., of Montreal, have been awarded the contract for power, lighting and telephone installation in a new building to be built in that city by the Hudson Bay Knitting Company, also lighting installation in A. Beck's new factory.

MONTREAL

Branch office of the Canadian Electrical News,
Imperial Building.

Montreal, March 31, 1903.

Toronto and some other localities in Ontario seem to wage increasing war on the Bell Telephone Company. Just why, we in Montreal cannot fathom. Down here we get a good, prompt service, and fair treatment generally, and those of us who have had the experience of two telephones in the office as in the days of the Federal Company found the situation more of a nuisance than a convenience. The telephone to be of any practical value must be a monopoly, although the government must be expected to safeguard the public against exorbitant rates.

The long looked for amalgamation of the Montreal Light, Heat & Power Company and the Lachine Rapids Company has at last come to pass. Just why such positive denials were made by prominent officials on both sides a few hours before the announcement, and after the deal was practically consummated, is a puzzle that no fellow can guess. Whether the deal will ultimately be of benefit to the public or no remains to be seen ; the consensus of public opinion at present, however, is to "expect higher rates." It must be borne in mind that there is a tremendous amount of power to be disposed of and the market for same has a limit even if the Montreal Street Railway is supplied. The street railway themselves will probably " come into the fold" ere long. The consolidation may have the effect of increasing the demand for isolated plants in factories, etc., in which case the wisdom of the Canadian General Electric Company in purchasing the old Royal Electric shops for the manufacture of dynamos and apparatus will be more than ever shown.

MOTORS FOR THE LACHINE CANAL.

Montreal, March 21st, 1903.

Editor Electrical News :

Dear Sir,—We note that under the heading "Sparks", the statement has been made that the Dominion Government has placed the order for electrical equipment of the Lachine Canal with us. This is correct, but the forty-nine motors are not to be all alternating. Thirty-one motors are alternating current, and are supplied by the Ampere Electric Company, of whom we are selling agents, and eighteen motors are direct current, and are being supplied by the Crocker Wheeler Company, for whom we are the Canadian agents.

Yours truly,
R. E. T. Pringle Company, Limited.

The Canadian General Electric Company have secured the contract to supply the Hamilton Electric Light and Cataract Power Company with five 100-light constant current transformers and 430 series alternating current enclosed arc lamps, with necessary switchboards and other accessories.

Defective welding of boiler tubes may be readily detected by chemical means, according to a communication by Mr. D. Woodman before a joint session of chemical societies at the Chemists' Club, New York. A certain lot of boiler tubes had given very poor results, corroding to failure very rapidly; another lot subjected to precisely similar conditions had been satisfactory. Submitted to Mr. Woodman for analysis, he found them to be of practically identical material—a fair quality of wrought iron. It was then suggested that possibly differences in the welding might have something to do with the behavior of the tubes. This was tested by laying sections of each kind of tubes in 10% sulphuric acid. The good tubes were attacked uniformly all around, the line of the weld showing merely by its color. The other tubes, however, were eaten away on the line of the weld very rapidly, so that a deep slit was formed there. This indicated that the metal along the weld was porous and open; in other words, that the weld was imperfect.

Railway Line Material

FOR ALL SYSTEMS.

Pole Brackets
Single and Double, All Standard Styles.

Trolley Clamps
for Round, Figure eight and Grooved wire.

Strain Insulators
Premier, Type D. and Brooklyn.

Trolley Hangers
Single and double curve and straight line

Trolley Ears
Strain, Splicing and Feeder.

Rail Bonds
Bonding Caps, Channel Pins, etc.

All Standard Devices Made By The Ohio Brass Company Carried In Stock By - - -

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED.
HEAD OFFICE - - 14-16 KING ST. EAST, TORONTO.

—District Offices—
MONTREAL HALIFAX OTTAWA WINNIPEG VANCOUVER VICTORIA ROSSLAND

MOONLIGHT SCHEDULE FOR MAY.

Date.	Light.	Date.	Extinguish.	No. of Hours.
May 1	7 30	May 2	4 10	8 40
2	7 30	3	4 10	8 40
3	11 20	4	4 10	4 50
4	0 00	5	4 10	4 10
6	0 40	6	4 10	3 30
7	1 10	7	4 10	3 00
8	1 45	8	4 10	2 25
9	2 10	9	4 10	2 00
10	No Light	10	No Light	
11	"	11	"	
12	"	12	"	
13	7 40	13	10 30	2 50
14	7 40	14	11 20	3 40
15	7 45	15	0 00	4 15
16	7 45	17	0 45	5 00
17	7 45	18	1 20	5 35
18	7 45	19	2 00	6 15
19	7 50	20	2 30	6 40
20	7 50	21	3 00	7 10
21	7 50	22	3 30	7 40
22	7 50	23	3 30	7 40
23	7 50	24	3 30	7 40
24	8 00	25	3 30	7 30
25	8 00	26	3 30	7 30
26	8 00	27	3 30	7 30
27	8 00	28	3 30	7 30
28	8 00	29	3 30	7 30
29	8 00	30	3 30	7 30
30	8 00	31	3 30	7 30
31	8 00	June 1	3 30	7 30
		Total............		161 40

TEST OF A TRANSFORMER.

A recent flood in the city of Montreal was the cause of an unconscious, yet interesting, transformer test. Two 25 kilowatt type A O transformers became submerged in water and remained in that condition for 48 hours. When the water subsided they were found in operation and performing the usual duties. This is a good illustration of the excellent construction and durability of the modern transformer.

VINCENT

BRONZE DISCS

Outlast All Others
Therefore it Must be

ECONOMY

A Combination of Good Points.

TO USE OUR

Globe and Gate Valves

VINCENT VALVE CO.,
SANDUSKY, OHIO, U. S. A.
79 KING STREET EAST, TORONTO, ONT.

The McEwen High Speed Automatic Engine

The McEwen High Speed Automatic Engine is an honestly constructed engine. It's honest all the way through.

Not a single item enters into its make-up but what has been tested and proven true.

For a high speed engine the McEwen is an economical engine.

Its regulation is perfect and it gives a most satisfactory service for the special purposes for which it was designed.

OUR GUARANTEE

The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution.

Any engine failing to meet this guarantee becomes the property of the purchaser upon the payment of one dollar.

For street railway service, electric lighting, electric crane work, mine haulage or any service where loads fluctuate with rapidity the McEwen is the ideal high speed engine.

Its guarantee given herewith proves our contention that the McEwen has almost perfect regulation. We should be pleased to send you the catalogue of the McEwen showing its construction embodied in its making.

THE WATEROUS ENGINE WORKS CO., Limited, Brantford, Ont.
Branches: Winnipeg and Vancouver

PUBLICATIONS.

The Westinghouse Electric & Manufacturing Company, of Pittsburg, have issued a neat and attractive booklet descriptive of Westinghouse fan motors for alternating and direct current circuits. In it are illustrated a few of the many adaptations of fan motors in stores, hotels, restaurants, steamers, trains, etc.

"The Induction Motor, its Theory and Design", by Boy de la Tour: This book has been translated from the French by C. O. Mailloux. It is intended to illustrate the theory of the induction motor and to facilitate its design by a practical method of calculation which is at once simple, ingenious and effective. The publishers are the McGraw Publishing Company, 114 Liberty street, New York, and the retail price is $2.50.

"Storage Battery Engineering," by Lamar Lyndon: This book has just been published by the McGraw Publishing Company, of New York, and retails at $3.00. It is a practical work intended for the engineer who is called on to design and install storage battery equipments or who has a battery power plant under his care. Various systems of boosters are minutely described. Altogether the book forms a complete compendium for the engineer, to which questions which may arise in storage battery work may be referred and satisfactorily solved.

In future Science Abstracts, of London, England, will be published in two sections. Section A will embrace physics, heat, sound, electricity and magnetism, chemical physics and electrochemistry, general physics, meteorology and terrestrial physics, physical astronomy. Section B will embrace steam plants, gas and oil engines, automobiles, driven ships and launches, balloons and airships, general electrical engineering, electric generators, motors and transformers, electrical distribution, traction and lighting, telegraphy and telephony. The subscription price will be $4.50 for each section separately including index, or for the two sections $7.50.

We are advised that Messrs. Peacock Bros. (late Francis T. Peacock) Canada Life Building, Montreal, have been appointed sole representatives for the Dominion of Canada for Messrs. Turner Bros., the well known English manufacturers of sheets, bars, forgings, stampings, etc., for electrical purposes.

POSITION WANTED

As traveller for an Electrical Supply Company; well acquainted with small supplies and well recommended. Box 25, ELECTRICAL NEWS.

TENDERS WANTED

TENDERS WANTED TENDERS WANTED

A Weekly Journal of advance information and public works.

The recognized medium for advertisements for Tenders.

CANADIAN CONTRACT RECORD
TORONTO.

ALUMINUM

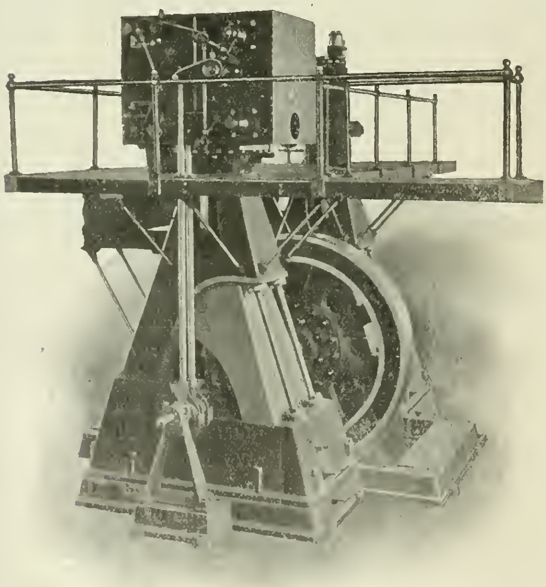
ELECTRICAL CONDUCTORS
FOR
RAILWAY FEEDERS AND TRANSMISSION LINES....

INGOTS, SHEETS, WIRE, TUBING, CASTINGS.

Prices with full information on application.

NORTHERN ALUMINUM CO.
PITTSBURGH, PA.

THE **LAURIE ENGINE COMPANY**
MONTREAL, CANADA.



Some Laurie Corliss Installations:

British Columbia Electric Ry. Co.	2,100 H. P.
Winnipeg Electric Street Ry. Co.	2,200 H. P.
Toronto Electric Street Ry. Co.	1,500 H. P.
Montreal Street Railway Co.	11,500 H. P.
Dominion Iron & Steel Co.	2,400 H. P.
Cape Breton Electric Tramway Co.	1,200 H. P.

LAURIE CORLISS ENGINES

UNAPPROACHED FOR ECONOMY, EFFICIENCY OR REGULATION

CANADIAN

ELECTRICAL NEWS

AND

ENGINEERING JOURNAL

VOL. XIII. MAY, 1903 No. 5.

POWER STATION OF THE DOMINION IRON AND STEEL COMPANY.

There are many interesting features worthy of notice in connection with the Dominion Iron & Steel Company's works located in the flourishing town of Sydney, Nova Scotia. It is a rare occasion for visitors to look over these works without being shown through the electric light and power station, where everything is kept in place and shining like a silver dollar. Visitors are invariably informed of the fact that everything in connection with this portion of the works is absolutely of Canadian manufacture—even the building itself, with a Canadian electrical engineer in charge. It was the first department to be completed. The building and machinery were erected within the time limit, and the plant has since been running without even a shut-down, which is certainly a credit to Canadian manufacturers. For the benefit of those of our readers who have not visited the plant the accompanying views are printed.

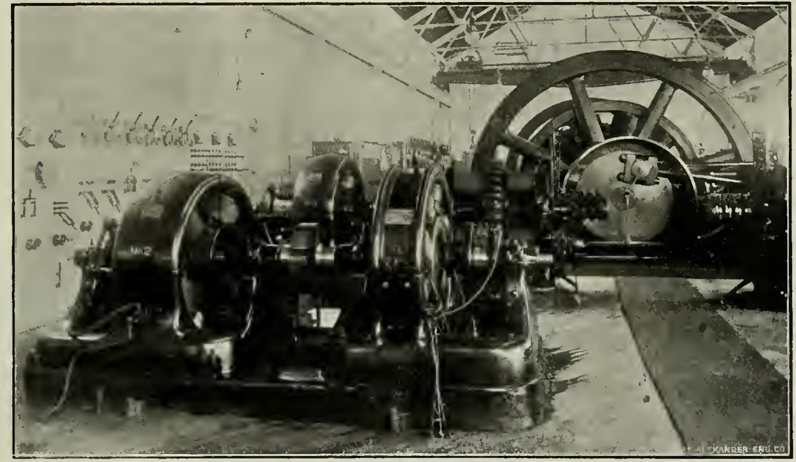
The gas from the blast furnaces being used for generating steam in place of coal, it became necessary to erect a large electrical station close to the boiler house, and from this station distribute electric power throughout the works for operating all classes of machinery, thus bringing the cost per h. p. down to a minimum. The power station is a modern brick and steel structure, 50 x 150 feet.

The station equipment consists of the following: Three 500 k.w. C.G.E. 250-volt, direct current, direct connected generators, operating at a speed of 90 r.p.m., each being connected to Laurie horizontal, cross-compound, Corliss type engines; three 125 light 4-circuit Brush arc generators, 6 6 amperes each, coupled direct to 90 h.p. 250-volt motors mounted on cast iron bases; two 60 kilowatt C. G. E., single phase alternating current generators, 1000 volts each, coupled direct to 90 h.p. direct current 250-volt motors, each set being mounted on cast iron bases.

The switchboards, which consist in all of 19 panels, are made of blue Vermont marble, equipped with C.G. E. M.Q. circuit breakers, Thomson astatic instruments for direct current, and inclined coil type for alternating work. Separate feeder panels have been laid out for the different departments, each furnished with ammeters, etc. A total load panel has been installed equipped with T. R. watt-meter, which enables them to take readings of total load daily.

Where arc lamps are required during day time, 250-volt power circuit is used, there having been installed a large number of lamps burning two in series. The Brush arc units are used for the all night service, there being upwards of 300 enclosed arc lamps installed on these machines.

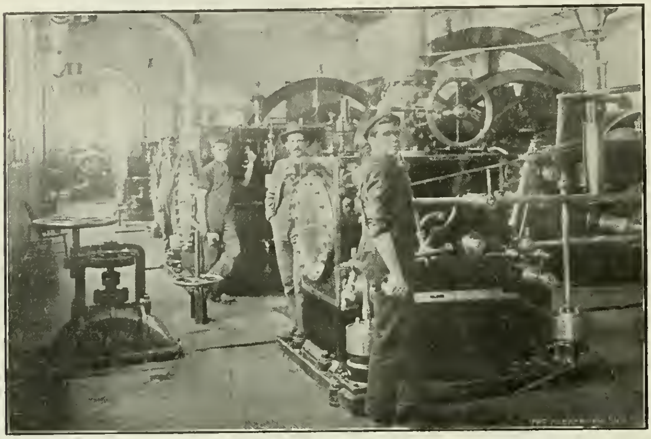
Although these works are not yet completed, there are over 6000 h. p. in motors connected to lines, every possible piece of machinery being electrically driven. A



POWER STATION OF THE DOMINION IRON & STEEL COMPANY—MOTOR GENERATOR SETS.

detail description covering this portion of the work was published in the ELECTRICAL NEWS of October, 1902, to which the reader is referred.

The trolley system operating the scale cars, the ore bridges, 50 ton cranes, and pushers in the open hearth furnaces is most interesting, and altogether the electric plant is looked upon as one of the most successful branches of the immense industry.



POWER STATION OF DOMINION IRON & STEEL COMPANY—ENGINE ROOM.

The complete power house equipment, lamps, etc., were furnished and installed by the Canadian General Electric Company, Limited, of Toronto, and the engines by the Laurie Engine Company, of Montreal. The building proper was erected by the Dominion Bridge Company, of Montreal.

Mr. W. B. Boyd, E.E., of Toronto, is in complete charge of this important department, and to him we are indebted for the photographs and particulars of the plant.

ELECTRICITY FOR UNDERGROUND HAULAGE.

Replying to a question as to how electricity can be applied to underground haulage, a writer in the Mining Record, of Halifax, N.S., submits the following:

I base my answer on practical observations which have from time to time come under my notice. I will divide my answer into sections which are all essential for the application of electricity to haulage.

(1) The first power.
(2) The dynamo and the motor.
(3) Suitable voltage.
(4) The connection of the motor to the haulage engine.

1. The First Power.—Whether the electric energy required is for the driving of haulage engines, pumps, coal cutting machines, or any other plant, it will first be necessary to have the initial or first power to drive the dynamo, which may be either a steam engine, water wheel, oil engine, or some other source of energy.

Generally speaking, we find that a steam engine is applied which necessitates the application of boilers for the raising of the steam.

The steam engine for dynamo driving that should be appreciated is one that is economical in running, not liable to break down, and one in which repairs can be easily executed at a small cost.

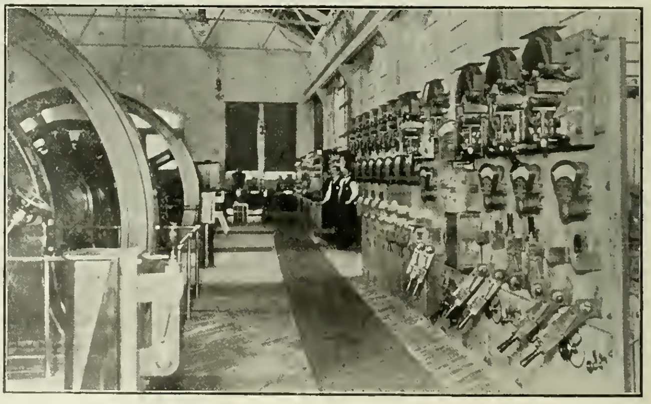
There are three distinct kinds of engines that have been applied, viz., the high speed engine coupled direct to the dynamo, the slow speed engine with rope or belt driving, the steam turbine coupled direct.

I have known each of these systems in practice, and each claims advantages under different conditions of working.

The first type of engine is a compact one and works extremely well where the load is even, the first cost being high. The greatest disadvantage of it is that the shock and strains are transmitted directly from the dynamo to the engine and vice versa.

Generally we find that haulage loads vary a great deal, most especially where the main rope and main tail rope systems are adopted.

The second type of engine and dynamo is certainly not so costly at first as the direct coupled engine, but the secondary cost is high by reason of a large engine house having to be made, and foundations for the same. These engines run very smoothly, and owing to the electricity of the ropes or belt gearing the shock on the engine and dynamo is not great, consequently very little wear and tear is caused, which means a great saving in repairs.



POWER STATION OF DOMINION IRON & STEEL COMPANY—SWITCHBOARD.

The third type of engine and dynamo does not require much room, as it is coupled direct. It is very quick running, and varies exceedingly little no matter what load is being conveyed.

The second type of engine has my preference, as it has given general satisfaction.

The Dynamo and the Motor.—I now come to the classes of dynamos that have been and are now used.

There are two divisions into which this machinery is divided, viz., the alternating current and the direct or continuous current.

The alternating current machines are periodic, being reversed in direction many times a second, the number of complete changes being known as the frequency of the current. These are divided into two main classes, viz , single phase (where only one current is generated), and two or three, or polyphase machines (two or more currents of equal frequency). Motors of this class have neither commutators nor brushes, nor wires on the revolving part, but simply two collecting rings for making connection with external circuit.

Power Station of Dominion Iron & Steel Company—Pole Line Leading to Open Hearth.

Continuous Current Machines.—The continuous current machinery has almost exclusively been used up to late, but now we find the alternating current system coming more in favor for underground use, most especially in fiery mines where sparks are a source of great danger. These continuous current machines are divided into three principle classes, and are in general self-excited machines—that is, the field magnetism is produced by the machine's own current—according to the manner in which the field magnets are wound, so that they may be energized by the whole current, a derived part of the current, or a combination of the two arrangements. The classes they are known by are as follows: (1) Series wound machines; (2) shunt wound machines; and (3) compound wound machines.

Both these systems (alternating current and continuous current) have been employed for underground haulage. I have known both main rope, main and tail rope, and endless rope haulage, driven by the shunt wonnd and series wound systems, and I consider that the series wound is the best system for the two former modes of haulage, and the shunt wound system for endless rope haulage; and for an underground fiery mine I prefer the polyphase system in preference to the continuous current system.

Suitable Voltage.—The commercial voltage used for underground purposes has varied a great deal, depending on the conditions under which the electrical machinery is to be run, but a practical voltage (electrical pressure or electro-motive force, that is, the pressure that is required to send one ampere through a resistance of one ohm) of 400 to 560 meets the safe and economical requirements; higher pressures have been known to cause great shock in the cable and damage to the insulation of the dynamos and motor,

The Connection of the Motor to the Haulage Engine.—This has been done by direct coupling, by spur gearing, by worm gearing, and by rope and strap connection. The rope and strap connection has had many advantages, and is worthy of such appreciation, as it prevents jerks and shock to the machinery, and consequently gives a longer life to such machines.

Some prefer to have the generating station at the surface, whilst others prefer the dynamo fixed underground.

It is better to fix the dynamo on the surface and convey the cables down the shaft, than to carry a large column of steam pipes down the mine to drive the dynamo. The following is a description of an electric plant which has been erected by Messrs. Scott and Mountain, supplying a current and conveying the same 2,000 yards from the generation at another station at one colliery to work the underground haulage gear at another mine a distance of one mile from the shaft:

A vertical two-crank enclosed compound self-lubricating engine of 350 horse-power, and coupled direct to a 200 kilowatt, six pole dynamo of the continuous current type, the motor for driving the haulage gear being 200 horse-power, and connected by a strap arrangement from the motor to the gear, which is to drive several branches on the endless rope system.

TWO CURRENTS ON ONE WIRE.

At a recent meeting of the Cornell Electric Society at Ithaca, N.Y., Prof. Frederick Bedell, of the physics department of Cornell University, announced a new discovery in electric power transmission, whereby an alternating and a direct current may be sent at the same time. Experiments show great economy, the amount of copper being reduced one-half.

Power Station of Dominion Iron & Steel Company—Office of Mr. W. B. Boyd, Chief Engineer.

Messrs. J. R. Booth, of Ottawa, L. A. Barclay, of Whitby, and others desire to be incorporated as the Algonquin Lumber & Power Company, to do a lumbering business, develop power and build and operate railways in the counties of Simcoe, Peel, York and Dufferin and in the Georgian Bay district.

THE CASCADE WATER, POWER AND LIGHT COMPANY.

By W. G. McConnon.

All of the gold extracted from water is not taken directly in the form of metal. A power house for generating electricity proves a very efficient "stamp mill" for delivering "concentrates" in the form of volts. That this is appreciated by mining men is evidenced by the recently completed plant of the Cascade Water, Power and Light Company, situated at Cascade, B. C., and owned by the London and British Columbia Goldfields Company, Limited, representing an investment, in round numbers, of $500,000.

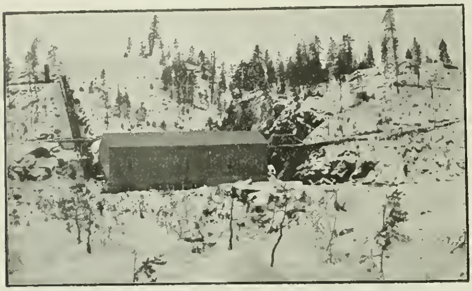


Fig. 1.—Exterior of Power House, Showing Pipe Line.

Cascade is a small town on the Kettle river, twelve miles east of the town of Grand Forks, and about thirty miles directly west from Rossland. Flowing from the west, the Kettle river descends 120 feet in passing through a half mile of narrow rocky gorge in a series of rapids and falls. For the utilization of this natural power, the Cascade Water, Power and Light Company has built a large dam, waterway, pipe line, power house and transmission line from Cascade to Phoenix, where the largest and most productive copper mines in the "Boundary District" are situated.

The dam, placed just above the entrance to the gorge, is of timber cribwork, with a 40-ft. base and 24-ft. top. The mid-section is 50 feet high, tapering to 25 feet at the sides, while the total length is 400 feet. This is built on a solid rock bed to which the foundation timbers are bolted and filled with 10,000 cubic yards of rock. This dam raises the water 36 feet above the natural level, giving an effective head at low water of 156 feet.

The permanent water level is 10 feet below the top of the dam, being controlled during high water by twelve sluiceways which can be opened to 12 feet below the natural river level, giving a passway of about 2,000 square feet. These sluices are closed by means of 12 x 12 in. squared timbers in grooves, operated by a travelling winch running on a track over the top of the dam.

From dam to power house the water first passes through a 225-ft. open rock cut from which it enters a tunnel driven through 410 feet of solid rock, passing under the track of the Canadian Pacific Railway, and then into another open rock cut 500 feet in length, at the end of which the bulkheads and controlling gates are located. These cuts and tunnel, representing an excavation of about 35,000 cubic yards of rock, are of dimensions liberal enough to avoid any appreciable loss of head, delivering the water with a head almost equal to that at the dam level.

From the gates the water is conveyed through a wooden pipe, 7 feet in diameter, for about 1400 feet. This pipe is constructed of Oregon fir tongued and grooved staves 2¾ inches x 7 inches, cut in circular segments and machined to the radius of the pipe. The staves are hooped at 12 in. intervals, with ¾ in. round steel bands, with cast iron connecting shoes for clamping.

Provisions have been made at the bulkhead and in the width of the cut for the installation of a similar and additional pipe.

From the stave pipe the water is carried through 250 feet of circular steel pipe, 7 feet diameter, resting on concrete piers and anchored into solid rock to avoid end thrust. Where this pipe passes alongside of the power house, three 4-ft. pipes and one 2-ft. pipe are taken off below the floor level of the power house to supply three 36-inch turbines for generators and two 12-inch turbines for exciters.

Fig. 1 is a general view of the power-house showing the stand pipe at the junction of the stave and steel pipes. This stand-pipe relieves the pipe line from excessive water-ram strains, and incidentally avoids any air taken into the pipes.

About 10,000 cubic yards of rock were removed for the site of the power-house, in a natural bay at the foot of the falls. This building is of substantial fireproof construction, 150x50 feet, with stone foundation 22 feet deep on the lower side, and brick walls 30 feet above floor level, the height to peak of roof being 45 feet. It has been designed with a view to lengthening it when required.

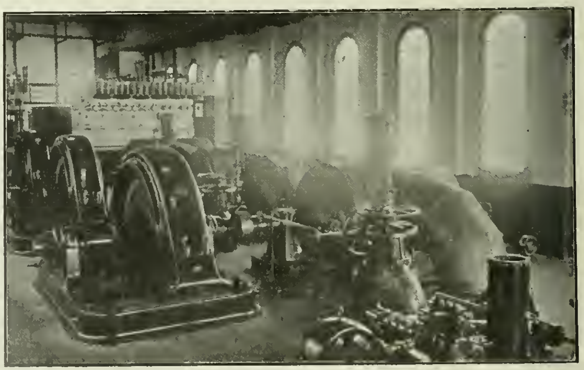


Fig. 2.—Interior of Power House, Showing Generators.

Fig. 2 shows the interior of the power house and the generating plant. The three generators are standard Westinghouse, three phase, two-bearing, direct-coupled, 2200 volt, 750 k. w. at 80 per cent. power factor, or 940 k.w. at 100 per cent. power factor, 60 cycles per second, 300 r.p.m. The two exciters, each capable of exciting all three generators at one time, are 45 k.w., 120 volt, shunt wound dynamos, self-contained, two-bearing type, direct coupled to independent turbines, with 500 r.p.m. The turbines are S. Morgan

Smith wheels made at York, Pa., and the governors the Esher Wies make from Switzerland.

Fig. 3 shows the transformers, nine in all, three in each bank, which are standard Westinghouse, self-cooling, oil-insulated type, having a capacity of 250 k.w. at 80 per cent. power factor, or 312½ k.w. at 100 per cent. power factor, "Star" connection, and wound for a ratio of 2,000 to 20,000 volts, on both high and low tension windings, with full load efficiency of 97.6 per cent. As the taps are brought out near the neutral point, which is grounded, it is impossible to maintain a dangerous voltage in the auxiliary circuit.

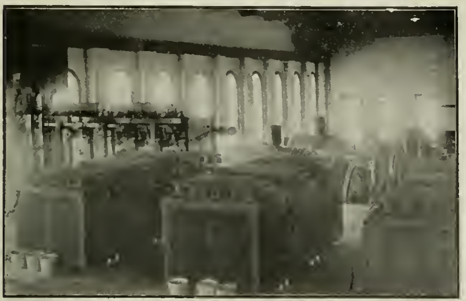


Fig. 3.—Transformers in Power House.

The current from the high tension side of the transformers is carried to a row of high tension fused circuit-breakers, situated alongside of the building behind the main switchboard, as shown in Fig. 3. These switches are of the well-known Westinghouse type, placed on independent marble slabs, with marble barriers between. The current leaving these switches enters a high tension bus and is carried to the line switches at the rear of the building. These line switches are grouped switches opening all three wires at the same time. Each switch is furnished with a time limit tripping device and reversed current tripping coils, so that overloads can be carried for a period of from one to ten seconds, as the local conditions call for, or either line can be cut out automatically in case of trouble.

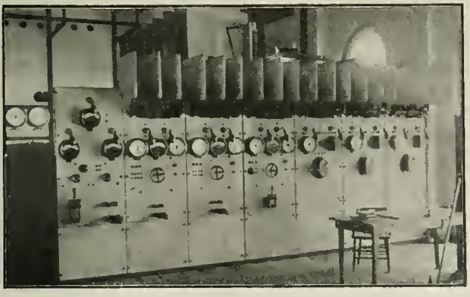


Fig. 4.—Switchboard in Power House.

The switchboard for the low pressure side, Fig. 4, consists of seven panels of blue Vermont marble, one panel for each generator, one for the two exciters, and a feeder panel for each group of transformers.

The six lightning arresters, located just above the switches in the gable of the roof, are the "low equivalent" style of the Westinghouse Electric & Mfg. Company, giving protection against lightning discharges for transmission at 20,000 volts.

A right of way 132 feet wide is cleared, and transmission lines erected from Cascade via Grand Forks to Phoenix, a distance slightly over 21 miles.

The high tension circuit consists of two separate three-phase transmission lines, each carrying three No. 3 B. & S. copper wires, with room on each line for another circuit. Throughout it is one of the most substantial and well constructed lines in the Dominion.

The poles are heavy cedar, and on tangents are spaced not over 100 feet apart, on curves at less distances, in some cases as low as fifty feet. No angles are turned, but all changes in direction of line made with easy curves. No side or head guys have been used except at extra heavy spans across rivers, etc.

The work on this line, as well as all construction of the plant, is a decided credit to the company's local engineer, Mr. Wm. Anderson, who has designed and executed the work.

A three-mile feeder is taken off at Grand Forks, twelve miles from Cascade, to the Granby Smelter of the Granby Mining and smelting Company, where current is used for driving Westinghouse induction motors of sizes ranging from three to seven hundred horse-power, and of an aggregate capacity of 2400 horse-power.

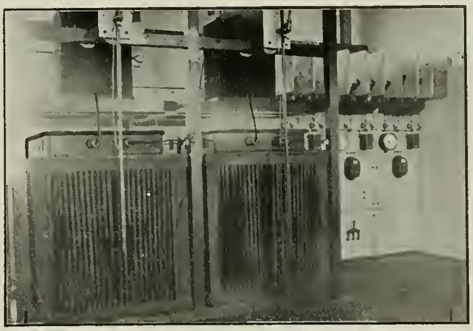


Fig. 5.—Interior of Sub-Station at Phoenix.

The sub-station at Phoenix is located at an altitude of about 3500 feet above the power-house. The building is of brick, with one end left for future extension, and contains the transformers, line switches, fused circuit breakers, switchboards, etc., substantially duplicating those at the power-house. Fig. 5 shows the interior of this sub-station, which for the immediate present will be called upon to supply current for two 700 h.p., Westinghouse, type "C" motors for driving two large compressors, a 100 h.p. motor for stone crusher, and a 150 h. p. motor for hoist, as well as furnishing the current for lighting the town of Phoenix.

The Cascade Water, Power & Light Company estimates that it will have a supply, at low water, for about 6200 h.p. This will enable the doubling of the present output. All the plans were made and carried out with the view of extending the plant to its full capacity, and from present indications it would seem that the company will have a demand for all the power it can furnish.

The Town Council of Orillia, Ont., are at present considering plans for improving and extending the power plant at Ragged Rapids.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.

BRANCH OFFICES:

Imperial Building, Montreal.
Bell Telephone 2299.

22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per aonum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.

1ST VICE-PRESIDENT:
EDWARD SLADE, General Superintendent Jacques Cartier Light & Power Co., Quebec.

2ND VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
ORMOND HIGMAN, Chief of Electrical Inspection Department, Ottawa.
ED. A. EVANS, Manager Quebec Railway, Light & Power Co., Quebec, Que
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
A. SANGSTER, Manager Electric Light & Power Co., Sherbrooke, Que.
A. A WRIGHT, M. P., President Electric Light & Power Co., Renfrew Ont.
GORDON HENDERSON, Sup't. Cataract Power Co., Hamilton, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON, - -	Toronto.
Vice-President, CHAS. MOSELEY. -	Toronto.
Treasurer, A. M. WICKENS, - -	Toronto.
Registrar, J. G. BAIN, - - -	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN, - -	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitcheli.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER -	Baden, Ont.
Vice-President, H. E. TERRY,	Toronto, Ont.
Secretary, W INGLIS, - -	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont.
Conductor, J. STRUTHERS, -	Sarnia, Ont.
Door Keeper N. BEAN, -	Waterloo, Ont

High Tension Wiring In a recent paper given before one of the Cleveland engineering societies by Mr. Paul M. Lincoln, of the Westinghouse Company, some interesting points were brought out as to the best method of high tension wiring inside power stations and similar buildings. Practically all modern plants now use some form of cable, insulated with rubber and in most instances protected by a lead sheathing. This, it was pointed out as the author's experience, should be installed on insulators which are designed for the voltage of the circuit of which the wiring forms a part, and thus be capable of controlling that pressure should the cable give way; in fact the cable insulation proper should be looked upon more as a protection against accidental contact than as insulation proper of the circuit. In support of this view several cases were cited in which cables, installed in ordinary racks, had given trouble by breaking down, either at points where they were supported, or else at the end of the lead sheathing. The recent shut down at the Niagara Falls plant might be taken as a warning against the growing tendency to bunch all sorts and conditions of cable into one confined situation where trouble, once started, may find it an easy manner to cause an interruption, more or less lengthy, to the whole service, to say nothing of the possible damage to the equipment.

Street Car Brakes. In the designing of new railway systems, or the adding to plants already in service, it often appears that so much stress is laid on the power to start quickly, that the equally important point of the ability to stop promptly is entirely lost sight of. That this is but too true will be self evident to anyone who cares to observe the operation of the brakes on the great majority of our street railways, where in too many cases it would appear as if that part of the equipment received but scant attention until it was positively unable to do further work. The schedule time, it should be remembered, can be increased by quick and businesslike stops just as much as by fast starts, and further, with less expenditure of power. Nothwithstanding this, many of our systems have cars in service with the shoes hanging at all distances from the wheels, the brake chain and mechanism with two or more turns of slack in them, and the adjustment such that some wheels are sliding long before the balance have anywhere near the proper shoe pressure applied to them. Further than this, the leverages are so proportioned or the mechanism so set that herculean efforts are required on the part of the motorman before he can produce any effect, in addition to which he is sometimes required to do his sanding by means of a shovel. This of necessity means that only one rail is so treated; the results in the shape of twisted trucks and car bodies can easily be imagined. The remedy for all this is careful and frequent inspection and adjusting, and the providing of proper sand devices for both rails, outlays which will soon prove themselves to be fully justified, producing as they do, the power to make a faster schedule and also having a tendency to lessen accidents. Further than this, it is probable that the energy required to operate a car whose braking mechanism is always in good shape will be found to be less than that required if this part of the equipment is entirely neglected, as in the latter case it is found that motormen run with the shoes caught up slightly to the wheels, in order to minimize the time required to set them for a stop. Some tests made on a power braked car, the brakes of which, if required, can be set practically instantaneously, shewed that it consumed on the average some 12 per cent. less energy than a similar vehicle equipped with the hand brakes, the result being explained as due to the above.

Street Car Stops.

A street railway system, to be of the greatest value to the greatest number, and in that way to produce the largest possible earnings, must not only offer to the public a means of relieving them from the manual labor of self-transportation, but must in addition perform that work in a much shorter time than it can otherwise be done. In other words, the question of time continually appears as the deciding factor of ride or not to ride, and to insure the quickest possible schedule, especially in city work, it is most essential that the time occupied by the stops be reduced to the minimum. Almost the only factor affecting the length of stops on an ordinary city car (and herein is a difference between standard long distance steam and electric railroading, where conductors have to make reports, engines have to be inspected, etc.) is the time required to discharge the passengers who desire to leave the car at that point and to take on those awaiting ingress. Any reduction, therefore, which can be made in the time consumed by this operation will be a distinct gain towards an increase in the schedule, and as one means toward that end it would seem that the plan, which has often been suggested in connection with steam railroading, of using one of the car doors for ingress, and the other as an exit, has many points in its favor. On almost every street railway system which operates cars with two entrances there can daily be seen the spectacle of the incoming and outgoing passengers bunched in a jostling crowd, both tempers and clothes get spoiled, and the car waits almost twice as long as is really necessary. Will not some enterprising manager of one of our roads inaugurate the practice? Like all new plans, it will doubtless meet with opposition, but it would appear to possess large possibilities of increasing the average speed of city cars, and once this is plainly demonstrated to the public which uses them, it will without doubt meet with the hearty approval and cooperation of all travellers.

Electrical Equipment for the Rapid Transit Tunnel.

The contract for the motors for the Rapid Transit Tunnel in New York has been awarded after a long series of tests, extending over some time, made under the direction of Mr. L. B. Stillwell, who prepared the specifications under which the sample machines were manufactured. The order, which calls for a total of 680 motors, was divided equally between the General Electric and Westinghouse companies, the former to supply their No. 69 motor, and the latter their No. 86. Both are rated at 200 horse power, their normal input being 300 amperes at 570 volts, and are designed to meet the special requirements obtaining in this particular installation. One of the greatest limitations was, of course, that of space, and as a result the designs submitted are probably of smaller size for their output than any others yet produced, coming as they do within the narrow confines of a standard gauge track and a 33 inch wheel. As is natural in view of the fact that the duties required and the spaces available are practically duplicates, the two designs approach each other quite closely in some directions and are quite widely apart in others. Both use cast steel frames and laminated poles, which are standard practice to-day, the General Electric Company presenting their box frame type, in which the held is cast in one piece, the armature field coils and poles being removed through openings in the end, normally closed by malleable iron heads which carry the armature bearings, those for the axle, which passes outside the frame, being carried in the ordinary manner by axle caps bolted to the frame. The Westinghouse Company design differed radically from the foregoing, they retaining the construction generally adopted for the smaller motors, of casting the main frame in two distinct pieces, recesses being provided in both top and bottom halves for the reception of the corresponding parts of the armature and axle bearings. They also added the somewhat unusual feature of extending the main frame so as to make it completely enclose the car axle. The weight in both cases is about the same, the G. E. Co.'s product being 6000 lbs. and the Westinghouse Co.'s about 10 per cent. heavier. The field coils in both cases are composed of copper strip wound on edge, and provided with liberal insulation, the Westinghouse machine possessing an additional precaution against damage in that the coils are completely sealed in metal cases. Both companies retained the standard railway motor practice of soldering the ends of the armature coils directly into the lugs of the commutator bars, though in the G. E. Company's machine there is a joint at the back end of the armature winding, while the Westinghouse Company made their s of a continuous copper strap.

The General Electric Company were also successful in obtaining the order for the complete controller equipment, which will be of their multiple unit type M form. The main point in which it differs from previous installations of the same character is in the addition of a current limiting device, the grouping into one frame of two or three contactors of the same potential and the arranging of the connections so that each motor is provided with its own set of rheostats, instead of having one set common to all the motors on a car, as has been the case with other installations. The most valuable feature appears to be the current limiting device, which takes from the motorman the power to accelerate at more than a given and determined rate, thus preventing abuse of both the equipments on the cars and incidentally those in the power station. The device is very simple, consisting mainly of a spring connection between the handle and the drum of the master controller, and a relay in series with the main circuit, which, if the current rises beyond the limit desired, locks the cylinder, and prevents it moving further until the car has accelerated and the current fallen. The handle can in the meantime be moved to the ultimate position desired, the cylinder following as fast as permitted by the relay.

The promotors of an electric railway from Toronto to Hamilton, are Messrs. Charles L. Denison, F.A. Drake, J.T. Gilmour, J. B. Gilmour and F. H. Markey.

WIRELESS TELEGRAPHY AND TELEPHONY.

Many persons will be astonished to learn that one of the first wireless telegraph stations on this continent, and certainly the first in Canada, is the Fighting Island station situated near the old historic Canadian fort at Amherstburg, Ont. It was established over a year ago in conjunction with a station at Detroit, and is still in actual operation, being controlled and owned by the Clark Wireless Telegraph-Telephone Company, incorporated by the State of Michigan. This company, at the head of which is Mr. Thomas E. Clark (a Canadian, born in the County of Essex), have their factory, laboratories and testing station at Detroit, Mich.

The international line between Canada and the United States was opened by the Mayor of Detroit, a copy of the message received being attested over the Mayor's signature as below :—

Executive Office,
Detroit, Michigan.

William C. Maybury, Mayor.

"Michigan has given to the scientific world many illustrious names. Among them Watson, the great seer of the skies : In geology, Houghton and Winchell: To the electric world Vanderpool, who first made practical the electric railroad. Here Edison received his first inspirations and now we may hope that a compeer, if not a greater than Marconi, may have arisen in this favored territory.

Correct as received,
William C. Maybury."

The Clark Company are making a special feature of the manufacture and supply of college and educational plants or apparatus. They will also supply complete plants to any companies wishing to go into the business of wireless telegraphy or telephony. They can furnish the smallest plant from an experimental students' set up to one for two hundred miles transmission.

When a representative of this journal called at the Detroit testing station, every facility was afforded him to test the accuracy of the messages received. He saw messages sent and answered, and himself personally received a message at Detroit, via "wireless" from the Fighting Island station.

The message as received comes over a ticker or receiver in the Morse code of dots and dashes. In the laboratory he saw wireless alarm bells, a button pressed at one end of the room started an alarm at the other end. The company have several patents already out covering new features in wireless work, one of which will do away with collisions on railways if the engineer is not deaf to an alarm bell. Another interesting thing shown to our representative was a small motor being driven by wireless current. He asked himself the question "when will the possibilities of electricity cease?"

Exterior View Wireless Telegraph Station Located at Fighting Island, Canada, Used as a Testing Station, and Equipped Complete for Telegraphing with Lake Steamers. Mast for Wires, 225 Feet High.

The diligence of Marconi, Clark and other workers all over the world has brought wireless telegraph-telephone apparatus past the experimental stage. Much remains to be done, but much has been done, so that both systems, and especially apparatus, have been put into what will no doubt prove to be a more or less final form and up-to-date.

Interior View of Fighting Island Station, Canada. Equipped with Complete Wireless Telegraph Apparatus.

Mr. Clark, the general manager, himself an electrician ot considerable experience, formerly with the General Electric Company at Schenectady, N. Y., has associated himself with some of the best French and German experts, and a large new factory is about to be built at Detroit.

We have much pleasure in giving an interior and exterior view of the Canadian testing station at Fighting Island.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.

The arrangements for the annual convention of the Canadian Electrical Association, to be held in Toronto on the 10th, 11th and 12th of June, are progressing satisfactorily. Arrangements have been made with the management to make the new King Edward Hotel headquarters of the convention. The business sessions will be held there, also the annual banquet.

Among the social features will be a Tally-ho drive to the principal points of interest in the city, by courtesy of the Canadian General Electric Company, also a visit by special cars to the extensive works of the Canada Foundry Company on the outskirts of the city, this by courtesy of the Canada Foundry Company. A number of other social features are under contemplation, so that visitors may rely upon the occasion being a pleasant as well as a profitable one. The Committe on Papers have succeeded in securing the necessary number, the subjects covering the different phases of electrical work, and the authors being recognized authorities on the subjects on which they write.

As the Association has a large membership in Toronto and throughout Western Ontario, it is expected that the attendance will be larger than usual. Every electrical company doing business within two hundred miles of Toronto ought to be represented at this convention, and would find it profitable from a dollar and cents point of view to do so, as subjects of practical interest will be considered and discussed. The complete programme will be published in our June number.

SUCCESSFUL ELECTRICAL AND ENGINEERING STUDENTS.

The examination results given out last month by the Faculty of Applied Science at McGill University, Montreal, show that the following electrical students were successful:

THIRD YEAR PRIZE MEN.

George H. Cole, Canadian General Electric scholarship; second mathematical prize; prizes for dynamics of machines, calculus and electrical measurements.

Howard K. Dutcher, Canadian General Electric scholarship; third mathematical prize; prizes for theory of structures.

Frederick W. McCloskey, Canadian General Electric scholarship; prizes for mechanics and calculus.

George K. McDougall, Canadian General Electric scholarship.

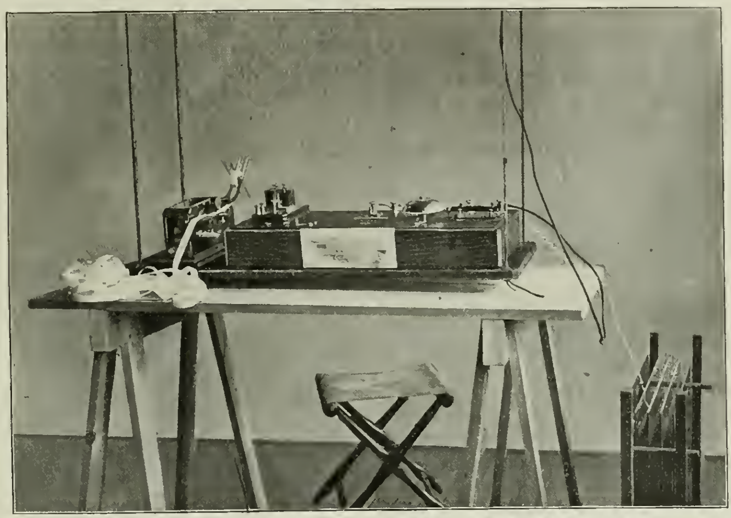
PASSED THIRD YEAR.

Electrical engineering — George K. McDougall, George H. Cole, and Frederick W. McCloskey, equal; Howard K. Dutcher; John H. Cardew; Louis H. Marrotte, and John Al. Wagner, equal; George W. Scott; John S. H. Wurtele.

PASSED SECOND YEAR.

Electrical engineering Robert W. Boyle, William C. McD. Cropper, Sidney G. F. McDermot, and Charlie Willard, equal; Gavin T. Scouler; William Redpath; Ian McLeish; E. W. Bowness; Staton H. S. Cunha; Hazen A. Wheaton; Delmer C. Findlay; Hiram H. Archibald, and Gordon B. Glassco, equal; John A. Campbell; George A. Johnstone; Kenneth E. Drinkwater; Roy A. Weagant; Oswald A. Mundy; Lockwood Burpee; Ernest A. Piche; Donald McLean; Clifton H. Wright; Alan Dale Harris; A. Pinto Joseph; E. Courtlandt Eaton; Lawrence L. Price; Walter C. Ross; George L. Dickson.

The Hinton Electric Company, of Vancouver, have installed a large electric light plant for the Brunette Saw Mill Company, of Sapperton, B. C. It will be used for lighting the mill, offices and yards.



Fighting Island Station, Canada. Interior View, Showing Wireless Telegraph Receiving Instrument Working with Transmitter Station, Detroit.

HINTS FOR THE DYNAMO TENDER.

By R. Max Eaton.

An attendant for electrical machinery should understand the elementary principles of electricity, the units of measurement and how to apply them, the laws and phenomena of induction, the principle involved in the different styles of dynamos, and have an intelligent knowledge of the electrical science in all its branches.

The following consists of suggestions covering some of the more important features with which a dynamo attendant should be familiar.

Cleanliness I place first on the list, for I believe it is the most important feature in the operation of a central station. What a story the appearance of a dynamo room and the machines tell to a close observer.

It is unnecessary to comment, to any length, on this point, because the fact has been so well established, that the greatest enemy to the successful operation of electrical machinery is dirt. The fact that a generator may be nicely painted and well finished does not increase its efficiency, but it certainly will act as an incentive for the operator to keep it clean and of a good appearance, and that of itself is of considerable importance.

Machines should always be cleaned immediately after they are shut down. Better results can be accomplished then than if allowed to cool, as it is then much more difficult to remove the oil and grit.

The dust and dirt in the inaccessible parts of a machine are most easily and surely removed by means of an air blast. The air blast is now used for this purpose, especially in stations having a number of machines to keep clean. The air is supplied through a flexible rubber hose, a small portable motor being used to operate the air pump.

If convenient a suitable canvas cover should be provided and placed over a machine after it has been cleaned to prevent dust settling on it.

Installation.—The location selected for the placing of a dynamo should be cool and dry and in such a position if possible that the machine will be easily accessible on all sides. Do not place it in such a way that it would be impossible to remove the armature without moving the entire machine. This is a mistake that is often thoughtlessly made. In placing dynamos of considerable size, a foundation of brick or stone should be provided, constructed if possible separate from the walls of the building. In any case a level and firm foundation ought to be provided.

In placing the parts of a machine together and mounting the apparatus the greatest possible care should be taken to thoroughly clean each part and all connections. The shaft and bearings must be thoroughly wiped before putting the armature in place.

Belting.—The kind of belting to be used is to a great extent a matter of opinion. The standard light-weight, double-leather belt is, however, applicable in most cases and as a general rule satisfactory. Use endless belts by all means, as it is not advisable to operate a high-speed machine of any description by laced belts.

In estimating the size of belt required to do a certain amount of work, it may be taken as a guide that a single belt will transmit approximately 1 H. P. for each inch in width when running at a speed of 1,000 feet per minute. If the speed is greater, the power transmitted will be correspondingly increased, and if it be less the power will be correspondingly decreased.

Always operate a leather belt with the smooth surface next the pulleys and the slack (running) side on top if possible.

On new belts an allowance for stretching should be made, in placing the machine, of ¼ of an inch to the foot in its length. In calculating for speed it is advisable to allow 1 per cent. for slipping, as it is certain to occur to this extent when doing work. Endless belts can be made without the use of rivets ; use specially prepared cement for splicing and avoid the use of rivets.

Directions for Starting.—Make a careful examination of the entire machine to see if the connections are all right and also to make sure that no tools have been left carelessly lying about. This sort of an examination becomes a second nature to attendants who have been operating machines for some time, and they unconsciously perform this very important proceeding without thinking that they are doing it. Note if the brushes are all set and have the proper tension. It is often customary to bring dynamos to their full speed before lowering the brushes into contact with the commutator. This is not at all necessary, in fact it is much better to place and set all the brushes before starting at all unless there is some danger of the machine being turned backwards, which would injure copper brushes. The main switch connecting a dynamo into the circuit should not be thrown in until the dynamo is "built up," that is, operating at the required voltage indicated by a voltmeter or pilot lamp ; however, this does not apply if a dynamo is operating an independent circuit, for then it does no harm to have the circuit on and allow it to build up with the machine. Never throw a heavy load on a generator suddenly if it can possibly be avoided, but gradually build up its load by means of circuit switches, or if operating in multiple with other machines, the shifting of the load should be done gradually.

Directions for Running.—If a machine s new and is being run for the first time, special attention should be paid to it for a while, and for a short time it is advisable to run it at less than full load if at all convenient to do so. Fresh oil should be added to the bearings quite often and the old run off. Be on the alert for excessive heating of the bearings, field coils, or armature, and if any is discovered no time should be lost in finding the cause and applying a remedy.

Special care should be taken in handling generators which are operating at an E. M. F. of 500 volts or over. "Keep one hand in your pocket" is an old saying ; however, this is not always convenient to do, but it serves to illustrate the impression we wish to convey.

Do not overload a dynamo, as this is the direct cause of probably as much trouble as any other individual thing.

Keep all iron or steel tools away, as they might be drawn into the machine by the magnetism and be the cause of entirely ruining it. Copper or brass oil cans should be used for the same reason.

Directions for Stopping.—If a generator is operating in parallel with others gradually remove the load until its ammeter indicates little or no current, then open the switch. Under no circumstances allow the speed to be lowered or the magnetism weakened (except enough to regulate the E. M. F.) before disconnecting. If this were done, the machine would probably run as a motor, taking its current from the main circuit, which might cause no end of damage.

If a machine is operating alone on a circuit, gradually decrease the speed and allow it to stop without touching either the brushes or switches. Do not switch out a dynamo at full or partial load except in a case of emergency.

Never lift a brush while a dynamo is generating current, except when there are other brushes on the same side to remain in contact.

As soon as a dynamo is "shut down" clean it thoroughly and raise the brushes, taking care to wipe all the copper dust from the commutator brushes, and brush holders, after which it should be covered, if a cover is provided.

Sparking at Brushes.—The causes resulting in this trouble are very different in different types of machines. Most all-arc dynamos spark considerably while operating, but that is not objectionable, as they are designed to stand it.

A few of the more common causes of this trouble in direct-current multiple machines are brushes not set at the neutral point, current overload, rough commutator, open coil in armature, short-circuited coil, leak from coil to frame, weak or uneven magnetism, bad brushes or unnecessary vibration of the machine.

If the sparking occurs from the brushes not being set at the neutral point it can be readily overcome by shifting the rocker arm either back-wards or forwards until the neutral or non-sparking point is found.

An overload will produce sparking, as probably the capacity of the commutator and brushes may not be sufficient, and in this case there is no remedy except to reduce the load.

It is not a difficult matter to keep a commutator which has no inherent defects in good condition if attended to properly from the start; but if allowed to get rough and full of ridges it takes considerable care and work to bring it right. It is very damaging to a machine to run it with the commutator in bad condition.

An open coil can be detected by a spark that will appear to travel almost around the commutator. The defective coil can sometimes be found by noticing which bar is most damaged by the spark. If there is not time to repair it the dynamo may be operated for a short while without damage by connecting the two bars together between which the open coil exists. An open very seldom occurs in the coil itself but more generally where the wire is connected to the commutator bar. This is easily found and remedied.

A short-circuited coil will heat much more than any of the others and is very liable to burn out entirely. It may be detected by holding a piece of iron between the pole pieces and in such a way that it will be influenced by the magnetism, and if the pull varies suddenly at a point in each revolution it demonstrates that a defective coil exists. Of course this test must be made while the machine is generating current.

A leak from the windings to the frame may be detected by testing with a magneto bell or by the use of a battery and telephone receiver.

Weak or uneven magnetism will cause sparking and also result in the dynamo not generating its full E. M. F. when running at the required speed.

The brushes should sit on the commutator in such a way that the intended contact service shall all be in contact, and also they should have no ragged edges but ought to be kept properly trimmed.

It may be said that excessive heat exists if the armature or field coils get too hot to keep the hand on for a short time.—Electricity.

ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

The eleventh annual report of the General Electric Company for the year ending January 31st, 1903, has been issued. It is shown that the profits of the company for the past year were approximately $10,000,000. An expenditure of approximately $1,600,000 was incurred chiefly in acquiring the patents of the Sprague Electric Company.

The total sales during the year were upwards of $36,000,000. The orders received included: Generators and rotary converters, capacity over 590,000 kilowatts; railway motors, more than 11,000, capacity over 490,000 horse-power; transformers, capacity over 475,000 kilowatts; stationary motors, more than 16,000; arc lamps, more than 80,000.

Water-power enterprises have been equipped with 428,269 horse-power in General Electric generators. There are now also in operation twenty-four plants equipped with 41,820 horse-power in General Electric generators, which plants are operated partly by steam and partly by water power.

Expenditures aggregating about $2,500,000 exclusive of the cost of patterns, small tools, etc., have been made during the year for real estate, extensions to existing buildings and the erection of new ones, and for additional machinery—all required to take care of the increased business.

The following table shows approximately the increase in floor space and in the number of employees during the past five years:

	Factory Floor Space in Square Feet	Factory Employees
1899	1,800,000	8,000
1900	2,000,000	11,000
1901	2,300,000	12,000
1902	2,500,000	15,000
1903	3,000,000	18,000

The report says: "Engineering work of the past year has been largely devoted to the development of established lines of apparatus. The number and variety of useful applications of electrical machinery have kept pace with the increased volume of business. Standard apparatus has been improved in quality and efficiency, and considerable special apparatus has been designed and manufactured to meet novel conditions.

"There has been a large increase in the equipment of industrial establishments with electric motors, the advantages of the electric motor drive being more clearly recognized with the increase in the number of its applications. Business in such applications showed an increase of forty per cent. during the past year. This increased use of the electric motor has been especially notable in the case of cotton mills, steel plants, cement works, oil refineries and machine works.

"By the purchase of the Sprague patents we have come into possession of the only fundamental and detailed patents, outside of those already owned by our company, covering a successful and satisfactory form of multiple unit control. This system, now known as the Sprague General Electric system, is in successful operation on many roads."

It is interesting to note that the size and voltage of generators and transformers used in connection with long-distance transmission have greatly increased. There are in successful operation transformers of over 50,000 volts, and orders have been secured for others to be used at 80,000 volts.

THE TAYLOR-WHITE PROCESS OF TREATING TOOL STEEL.

Of great interest to all manufacturers and users of machinery is the Taylor-White process of treating tools made of self-hardening steel. This process is the invention of Mr. Taylor, of the Bethlehem Steel Company, South Bethlehem, Pa. The owners of the Canadian patents are the Goldie & McCulloch Company, Limited, of Galt, Ont., who advise us that all the tools they use are treated with this process and that the results have been entirely satisfactory in every way.

It seems that the development of this process of treatment grew out of the necessity for increased output in the machine shop of the Bethlehem Steel Company. The capacity of the forge was far in excess of that of the shop, leading to a large accumulation of forgings awaiting their turn. Mr. Taylor turned his attention to the investigation of the tool steels employed, systematic tests being instituted to determine their comparative merits. It was found that by a special treatment all of the air-hardening steels could be more or less improved, but in order to obtain the maximum of uniformity and efficiency a special composition was required. It will therefore be seen that the new element introduced is not so much a new steel but a new treatment of existing steels. The nature of this treatment is not yet disclosed.

The effect of the treatment on the output of the works was remarkable. Whereas prior to the introduction of the new process the capacity of the forge was far in excess of that of the machine shop, the machine shop now leads the forge, and the latter is being pushed to its utmost to keep the former supplied with material.

Another effect is seen in the increased speed of the line shafts. Formerly, these ran at 90 revolutions per minute, but to obtain the full benefit of the new process it has been found necessary to increase this to the unusual figure for a machine shop of 250 per minute. The countershaft speeds are also being rearranged.

From a report of tests made by the Bethlehem Steel Company we reproduce the following: Regarding the nature of the change in the steel which is brought about by the new treatment, it appears to be simply the raising of the temperature at which it begins to lose its temper. With ordinary steel this temperature is about 500 degrees Fahrenheit, whereas with the treated steel it is about 1100 degrees. The latter temperature corresponds to that of dull redness, and in the test run on the piece of machinery steel the tool became, in fact, distinctly red hot. At this temperature of the tool the appearance of the work was distinctly better than that of the usual roughing cut. The surface was not, of course, a finished surface, but it was a clean-cut surface with none of the torn appearance characteristic of the usual roughing cut.

The chips themselves left the tools at a temperature which drew them to beautiful blues and purples, and this coloring of the chips is the practical shop test of the correct speed of the work. Without water the color of the chips, whether the work is completed or in progress, tells the foreman whether or no the work has been done at the proper speed. In the case of the experimental lathe the Evans cone enabled the exact speeds to be obtained in all cases, and, as stated, the chips were all drawn to blue and purple; but in the case of other tools, having only the usual stepped cone pulleys to regulate the speed, it is not always possible to get the exact speed to produce these colors in chips. It is, however, expected in all cases that the chips will show some color. Where water is used the chips will show no color, but it is then only necessary to turn off the water for a moment to bring out the colors and show if the speed is correct.

It is interesting to note that the tools themselves are not especially hard. Comparison of these tools with Mushet tools by the file showed the latter to be distinctly the harder of the two. It should also be said that, unlike Mushet and other self-hardening steels, this steel is adapted to the making of milling cutters and other tools requiring machine work to be done upon them. Tools of this character were shown, and one of them, which is used in considerable numbers, was of a form which would be quite apt to crack in hardening, but it was stated that no difficulty is experienced in this respect, and the steel is believed to be less difficult to handle in this respect than is ordinary steel. The treatment is not a surface treatment, but is known to extend to the center of a 4-inch bar. The tools from it are easily forged—at least as easily as those from common steel, and much more easily than those from Mushet steel. The treatment is, however, applicable to Mushet steel, and improves it, though to a much less degree than it does the special steel.

It is stated that the development of this process has involved the cutting up into chips of over 200 tons of steel forgings, with an expenditure for material and labor of over $100,000.

TORONTO TECHNICAL SCHOOL.

The following students in electricity, physics and mechanics of the Toronto Technical School were successful at the spring examinations:

Steam Engine—Class I.—R. Steen, P. McCarthy. Class II.—H. Sheardown. Class III.—R. W. Blacklock.

Heat—Class I.—F. Jeffrey, O. B. Haug. Class II.—E. A. Fennell, F. W. Veale, W. Mauder, A. M. Osawa. Class III.—H. Belcher.

Hydrostatics—Class I.—F. Jeffrey, O. W. Haug, F. W. Veale, H. Belcher. Class III.—F. Beaumont.

Mechanics—Class I.—W. Duncan, C. E. Rundell, D. Ross, J. Linton. Class II.—H. Belcher, R. Jacques, A. S. Innes, R. W. Blacklock, G. Garton. Class III.—W. Boyd.

ELECTRICITY.

First Year—Class I.—J. A. Small, W. H. Atkin, J. McCulloch, A. Stewart, F. Jeffrey. Class II.—J. Smith, F. Lewis, E. Machell, J. Godwin, D. Ross, H. Belcher, N. Deverall, C. Andrews, A. F. Burke, J. McCarron, F. Davis, J. O'Neil. Class III.—E. Kendall, W. R. Johnson, E. Stanbury, A. Baldwin, E. J. Dinsmore, F. R. Sheath, A. Simpson, H. Ray, N. Graham.

Second Year—Class I.—W. McCulloch, J.A. Small, W. Gale, W. H. Aitken, M. Adams. Class II.—C. Radford, J. O'Neill, R. W. Blacklock. Class III.—W. J. Leggatt, F. R. Davis, F. Slade.

Third Year—Class I.—J. McCulloch. Class II—C. Hand, G. Robinson, H. Satchwill. Class III.—C. Radford.

S. MORGAN SMITH DEAD.

S. Morgan Smith died in Los Angeles, Cal., on April 12th. He had been ill for several months. The direct cause of his death was attributed to heart failure.

The news of his death was a shock to his many business and personal friends. While not a native of York, he resided there for so many years that he became an integral part of that city in its rapid growth. That fact was attested when he first launched into the manufacturing side of that city's interests. Through his individual efforts the success that attended him is shown by the immense plant of the S. Morgan Smith Company, employing about 400 people, whose product is known not only in the United States, but in all foreign countries.

S. Morgan Smith was born February 1st, 1839, in Davis County, North Carolina. He was educated in the public schools of Davis County, North Carolina, and later on attended the Moravian College at Bethlehem, Pa., from which institution he graduated in 1861. During his college course he prepared himself for the ministry and from 1861 to 1866 he was pastor of the Moravian church at York, Pa. In 1864 he was elected chaplain of the Two Hundredth Regiment Pennsylvania Volunteers, in which capacity he served until the end of the war. In 1866 he went to Canal Dover, Ohio, where he had charge of a congregation for five years. Here he was forced to quit the ministerial work on account of a serious throat affliction and he returned to York.

The Late S. Morgan Smith.

About this time he began giving his attention to the perfecting of a washing machine, known as the "Success," which he invented and had patented. Thousands of these machines were sold. In 1875 he became interested in the manufacture of water wheels. His first wheel was known as the "Success," many of which were installed in mills and factories throughout the country. Later he placed upon the market the "Improved Success," a wheel giving more power than the "Success" of the same diameter. He found ready sale for great numbers of these wheels and many hundreds are in use driving all kinds of machinery. In 1892 he engaged in the manufacture of the "McCormick" water wheel, which has gained a "world wide" reputation. Since he began the manufacture of the last named wheel he has supplied many of the largest plants in operation in the United States and Canada and has shipped extensively to foreign countries. Although the shops were small in which he started the manufacture of water wheels, they have assumed such proportions that at the time of his death they were beyond question the largest and best equipped in the country devoted exclusively to the manufacture of water wheels and power transmitting machinery.

Electrical manufacturing companies have been figuring on a large quantity of machinery and apparatus required by the St. John Street Railway Company, of St. John, N. B. It is estimated that the proposed improvements and extensions to their plant will cost about $300,000. The trackage will be increased from 12 to 18 miles, for which purpose an order for 90-pound rails has been placed with a Glasgow concern.

MONTREAL

Branch office of the Canadian Electrical News,
Imperial Building.

Montreal, May 9th, 1903.

During the longshoremen's strike at the wharves here the linemen refused to erect poles and run wires on wharf properties in sympathy with the longshoremen. Naturally, a good deal of inconvenience was felt through lack of usual arc lights in sheds. It is stated that the local chief (?) of the electrical workmen's union was a former employee of the Montreal Light and Power Company who was discharged for refusing to obey orders.

Complaints are made by some parties using D. C. motors supplied with current formerly by the Standard Company that the new regime, the Montreal Light, Heat & Power Company, will not renew contracts unless for A. C. current. Surely no such arbitrary decision has been promulgated. It would be gross injustice to put merchants to the expense of purchasing new motors if the power company have D. C. lines in the immediate vicinity. D. C. must be supplied to several elevators, and although new customers might be refused D. C., or old customers who move from close proximity to the D. C. lines, there seems no reason why, when the current is there, that old customers cannot renew their D. C. contracts. Besides, those who require variable speed cannot well get along with A. C. This takes no account of price, which will no doubt be increased, but merely to the kind of current supplied.

Mr. F. H. Badger, City Electrician and Superintendent of the Fire Alarm Telegraph of Montreal, was taken ill rather suddenly lately and had to be taken to Portland, Maine, for recuperation. He writes a friend, however, that he is now making rapid strides towards recovery, and hopes to return to Montreal shortly. Meanwhile his duties are filled satisfactorily by Mr. J. A. Ferns, of the fire alarm staff.

The complete back-down and ignominious surrender of the Montreal Street Railway officials during the late strike has, as foretold, brought along an unusual crop of strikes this spring. Carpenters, etc., affected the interior wiring contractors, and now the linemen of the Montreal Light, Heat & Power Company seem desirous of following suit. It is probable, however, that the words of the R. C. Archbishop will have good effect and prevent so much of it, coupled with the fact that the men are beginning to find that they get no public sympathy when led by Yankee agitators.

One point in the last annual report of the Lachine Rapids Hydraulic & Land Company is worthy of comment, viz., where they accuse the Underwriters of laxity in regard to inspections. The contention is only too true, but whose fault is it? Just so long as the Underwriters get this work done for them for nothing they most assuredly will not pay for an inspector. At present the company do inspections, as they claim, for the safety of their own plant in the shape of the meter and transformer, which is undoubtedly right, but do they stop there? Such reports as "D. B. wp'f wire used instead of 'slow burning'"; "cleats incorrectly spaced"; "tape used instead of bushings in sockets"; "moulding not sufficiently 'filled'," are examples, and which, although wrong from Underwriters' point of view, cannot be held to be likely to damage the company's apparatus. This detail inspection caused a certain company at one time to be mulcted about $5,000 in a case where the insurance companies sued for fire damage. The fact of the company assuming such inspection was no doubt a good legal point. The lighting companies' contracts would be the better of a clause stating they assume no responsibility for interior wiring; inspect for their own protection only, and let it go at that. The balance is up to the Underwriters to look out for, and as the loss would be theirs they would pretty soon awake to their duty, as they have done in cities the other side of the line.

The great quesion now among the various, companies' staffs is who is to go and who is to stay. Undoubtedly the consolidation will affect quite a few. There are some weeds which will be well rooted out, and also some who, although they have worked hard and conscientiously, will now be "de trop." It is hard on them.

QUESTIONS AND ANSWERS

"Dynomo Tender": (1). I am desirous of constructing an electro magnet or magnets combined that would be capable of lifting a piece or pieces of wrought or cast iron weighing from one to two lbs. at a distance of from 4 to 5 inches from magnet poles. I have 110 volt and 550 volt alternating current available. Economy of current no consideration. The magnet will remain in service for five hours at a time. The form of magnet pole face best adapted to the purpose would be say 3 inches wide by 8 to 10 inches long. Please give data that may be tried. (2). (a) How should I apply grease to large crown gears eight feet diameter that run continuously at 80 R.P.M.? (b) What kind of grease would you recommend? (c) Could they be run without grease? I wish to avoid as much as possible the grease flying in all directions. (3). (a) Can I use A.C. or D. C. current for ringing 1000 ohm telephones on metallic circuit instead of the hand generation of telephone, with, say, push button and lamp in series. If so, what voltage must be used? (b) What is the strength of the current from a thousand ohm telephone generator? (4). If cabon brushes for D. C. dynamo were soaked in dynamo oil or boiled in parraffin would it improve them? Is the practice recommended?

Ans.—(1). It is impossible to answer your question without further information as to the shape, etc., of the apparatus desired. You would probably obtain the best satisfaction by making up a trial form and using a rheostat in series with your coil. You will obtain the best results from the 110 volt direct current circuit. (2). A mixture of tallow and graphite, applied with a swab or brush, is suitable for the work, as are also various greases which can be obtained from oil manufacturers. It is scarcely practicable to run this class of gearing without lubrication. (3). You can ring your telephone by the alternating generator current, providing the periodicity is not too high. Direct current will not be satisfactory. You can reduce the current to the proper amount by the use of lamps in series, but would probably find a potential transformer to be more satisfactory. The proper voltage will be somewhere about 50 volts, which is approximately the pressure generated by a 1000 ohm instrument. (4). Dynamo oil has scarcely enough body in it to make it suitable for boiling brushes in, but paraffin is much better and its use is frequently recommended.

"Nova Scotian": Can you run a transformer for series arc lighting which is built for two circuits with all the load on one circuit only, or can it be run only up to half load if one circuit is taken away? The Brush Company's arc lighting machine, so I understand, is made so that one, two, three, or four circuits can be run from them. Is this so, and can the whole load be carried on any but the right number of circuits?

Ans.—Two circuit transformers for series alternating circuits, either arc or incandescent, as made by the Canadian General Electric Company, can be run with the load divided in any proportion desired between the two circuits, or all on one and none on the other. Brush arc generators are made for various numbers of circuits up to a maximum of four, depending on the size and style of the particular machine in question. The load can be divided, the same as in the alternating system, in any way desired between any number of circuits up to the maximum for which any given machine is built.

"J. F.," Montreal: Will a 60-cycle fan motor operate on a 125 cycle circuit and vice versa? Can a direct current motor be operated on an alternating circuit?

Ans.—It depends to a great extent on the particular motor you have, but generally speaking they will not. A 125 cycle machine will run on 60 cycles, but only at about half speed and with a somewhat greater current consumption. Re your last question, we presume you still refer to fan motors and would say that we understand that some companies are running d. c. motors on their a. c. circuits, though with what degree of satisfaction we are unable to say. Perhaps some of our readers may be able to give more information on this point.

"Electrician": Can a wattmeter which is built to go directly into a low potential secondary circuit be connected into the primary, with current and potential transformers, and operate satisfactorily? Will it need to be recalibrated?

Ans.—A wattmeter will operate without difficulty under the conditions you describe, provided the voltage of the potential transformer and the current of the series transformer are within its range. It will not need to be recalibrated, but you will have to alter the constant by an amount depending upon the ratio of the two transformers. Thus if the original constant was 2, and the current transformer has a ratio of 600 to 5, or 120, and the potential transformer a ratio of 2200 to 110, or 20, the new constant for the meter will be $120 \times 20 \times 2 = 4800$.

"X.Y.Z:" What is an inverted rotary converter? If you have to start from the direct current end of an ordinary rotary converter, and your voltage was so low that you could not get up speed sufficient to bring the machine into synchronism with the alternating lines, how would you get started?

Ans.: (1) An inverted rotary is one which instead of being used as they ordinarily are to change alternating into direct current, is operated to change direct into alternating. (2) You could connect the alternating end, after you had reached the highest speed you could, to the bus bars through a reactance. This would pull the rotary into step and yet not let too much current flow. Another method would be to weaken the shunt field as much as you could, by means of the rheostat, which would speed the machine up slightly, and then open the shunt field entirely. This will, of course, make the speed rise very quickly, and care has to be taken to open the direct current switch before it attains a dangerous point. The alternating current end can then be connected at the proper moment, during the time the speed is falling, the phasing lamps or other device showing the proper instant to close the switch.

The Bell Telephone Company are remodelling their system at Chatham, N.B. Among the improvements will be a new switchboard.

LIQUID FUEL FOR POWER PURPOSES.

To the May number of the Engineering Magazine, Mr. Arthur L. Williston contributes a valuable article on the subject of liquid fuel for power purposes. At the outset he outlines the numerous tests that have been made by the Pennsylvania Railroad, the Chicago, Burlington & Quincy Railroad and other corporations to ascertain the utility of burning oil. Recently there have been discovered new oil fields so extensive that there is good reason to believe that there is an assured supply to meet the demands of the future, while the construction of pipe lines which very materially reduce the cost of transportation, and the high price of coal, have combined to give a new argument for the burning of crude oil for power purposes. It is probable that during the past two years there has been greater increase in its use than in all the previous time since mineral oil was first discovered. Already some manufacturing plants in the Eastern States, which formerly have been dependent on the coal fields of Eastern Pennsylvania, have found themselves able to obtain a cheap supply of crude petroleum, or refuse oil, and are burning it under their boilers. Experiments of the United States Navy in this direction have already warranted the Bureau of Steam Engineering in recommending that on at least one-third of the torpedo boats and torpedo-boat destroyers, liquid fuel installation should be effected without delay ; and a Board of Tests of Liquid Fuel for Naval Purposes, authorized by Congress, is at present conducting an elaborate series of tests to determine the best conditions for oil burning on all classes of vessels, including the armored cruisers and battle-ships.

In California oil is rapidly driving coal out of the field for power purposes. The same is true in Texas, and of much of the territory lying between. The general use of oil has affected not only the power and lighting and manufacturing plants in these regions, but also the railroads and marine transportation as well. With the relative economy, at present prices, between the oil and coal varying from one-eighth to one-half or perhaps less, according to the cost of transporiation from the wells to the differeht points where the oil is consumed, this unusual development is not surprising, and the use of liquid fuel for power purposes is still rapidly growing.

One railroad operating in California is now burning oil on more than one hundred and eighty of its locomotives. Another of the great transcontinental systems is already using oil on about five hundred of its locomotives—which is 30 per cent. of the total number operated by the system—and is equipping others as rapidly as possible. In addition to the use on locomotives, it is using oil on its steamers in San Francisco Bay, and on its river steamers, wite very good results.

It seems to have been pretty definitely settled, says Mr. Williston, that better resnlts can be obtained by introducing the oil in the form of a finely divided spray by means of an atomizer ; and so far as the mechanical part of the problem is concerned it may be said that the greatest difficulty was overcome when it was first realized that the success of oil burning depended largely upon the efficiency obtained in atomizing the fuel. With the oil sprayed under the boilers in this way, it has been found that the fires can be forced at will—even to a degree beyond that which is possible with coal under forced draft. The rate of vaporization and the combustion of oil are limited only by the size of the burners and by the velocity with which the air and products of combustion can be forced through the furnace.

Both compressed air and steam have been successfully used as the atomizing agent, and the majority of the burners now on the market are designed with the openings adjustable so that they may be used with either. Most of these are patented devices, and a very large number have been brought out. The activity of the inventors in this direction can be judged from the statement made in the preliminary report of the Liquid Fuel Board, that new patents for liquid-fuel appliances were being issued in the United States at the rate of thirty a week. Nevertheless, there is a great similarity in principle and in action between these different burners. The author then describes and illustrates two or three of the typical burners in use.

ELECTRIC PROJECT FOR QUEBEC.

A project for an extensive electric railway system through the south shore counties and eastern townships of Quebec is now in tangible form. It is understood that two main lines will be commenced this season, one to connect Montreal with St. Johns by way of Longueuil and Chambly and the other between Montreal and Valleyfield, closely following the river bank and taking in St. Lambert, Laprairie, Chateaguay, and Beauharnois. The roads, according to Mr. F. S. S. Johnson, of Stanbridge, Que., are to be built with heavy tracks and in the most modern way, the cars being 10-odd feet in length, supplied with air brakes and motors capable of running at a speed of between 50 and 60 miles in straight stretches. There will also be parlor coaches for private parties.

It is claimed that this will be one of the largest electric railway systems in Canada, and it will form part of vast plans now being mapped out for an electric road to connect New York with Montreal. It is understood that connections will be made with the important trolley roads in eastern New York—the Berkshires—and nearly a dozen systems in Vermont. Among the lines that are expected to serve as feeders for the projected main line, besides the Montreal and Southern Connties Railroad, are the Troy Traction Company, the Bennington Hoosick Railroad, the Hudson Valley line, the Troy and New England Company, and the Berkshire Street Railway Company, with about fifteen other corporations of less importance. The scheme is reported to be backed by capitalists from New York, Boston and Chicago. The proposed main line from New York to the Canadian border would pass through much attractive scenery, the shore of Lake Champlain, which it will follow, being particularly beautiful. The Montreal and Southern Counties Railway route will also have the scenic advantages of the Richelieu and St. Lawrence rivers. It will further enable the farmers all along the south shore to reach the market of Montreal with their products. The company's intention is to make special arrangements for the carrying of all kinds of farm products between midnight and 6 a.m., thereby allowing the farmers to get their stuff into Montreal in good condition for the morning market.

The St. Francis Hydraulic Power Company are about to commence work on their proposed power plant intended to supply light and power to the mining districts of Black Lake and Thetford Mines, Que. The initial development will probably be 2,000 horse power. The company is capitalized at $500,000.

SCHOOL OF SCIENCE EXAMINATIONS.

The following students in the mechanical and electrical engineering course at the School of Practical Science, Toronto, were successful at the spring examinations :

Degree of E. E.—L. B. Chubbuck.

Honors—First year—H. W. Arens, R. H. Armour, B. Aylesworth, G. G. Be'l, W. M. Bristol, W. R. Carson, J. B. Charlebois, S. R. A. Clement, H. S. Fierheller, F. W. Harrison, W. G. Hewson, W. C. Jepson, G. Kribs, W. MacKinnon, S. E. McGorman, C. A. McLean, G. R. Munro, W. G. Nicklin, G. W. Paterson, C. E. Sisson, W. E. Turner.

Second year—A. M. Campbell, W. M. Currie, W. S. Gibson, W. W. Gray, C. P. McGibbon, W. H. Munro, A. E. Pickering, M. R. Riddell, R. S. Smart, W. J. Smither.

Third year—H. H. Angus, J. Breslove, A. E. Davison, F. A. Gaby, G. A. Maus, M. L. Miller, D. H. Pinkney, H. M. Shipe, S. B. Wass.

Pass—First year—F. W. Baldwin, T. R. Blaine, E. Chantrell, F. Dowling, H. M. Fletcher, J. M. Gordon, J. A. Howard, J. W. Leighton, W. D. Mackenzie, H. Mace, R. W. Moffatt, L. W. Morden, L. F. Pattee, G. B. Reynolds, W. L. Richardson, H. V. Serson, C. H. Shiriff, A. Simpson, W. F. Stubbs, L. R. Thomson, E. D. Tillson, A. E. Uren, J. Vaughan, J. H. N. Wilkie.

Second year—J. H. Barrett, M. B. Bonnell, T. D. Brown, R. J. Burley, F. W. Burnham, J. W. Calder, S. E. Craig, H. H. Depew, A. Gray, W. K. Greenwood, C. J. Harris, T. D. Henderson, W. S. H. Keefe, O. B. McCuaig, C. D. McKay, G. J. Manson, W. C. Milne, E. A. Moore, G. Pace, W. S. Pardee, J. Paris, W. J. Peaker, G. S. Roxburgh, P. M. Saunder, F. W. Slatter, C. J. Townsend, S. E. Thomson, B. B. Tucker, J. B. Watson, W. F. Wright.

Third year—H. C. Acres, J. A. Beatty, C. J. Fensom, R. E. George, J. G. Jackson, G. K. Johnston, A. G. Lang, W. J. Larkworthy, J. A. MacFarlane, P. H. Mitchell, E. E. Mullins, I. H. Nevitt, J. P. Oliver, J. D. Pace, B. B. Patten, S. L. Trees, H. F. White, J. A. Whelihan.

H. G. Smith passed the third year with aegrotat standing. H. S. Small has passed the third year, but has failed to comply with the regulations respecting practical work.

Mr. A. M. Wickens, for many years chief engineer, electrician and inspector for the Ontario Government, has resigned, to accept the position of inspector for the newly organized Canadian Casualty and Boiler Inspection Company, of Toronto.

HAMILTON ASSOCIATION OF STATIONARY ENGINEERS.

Good Friday eve for sixteen consecutive years has seen the members of the Canadian Association of Stationary Engineers at Hamilton meet for a banquet, and each year's gathering has been an improvement on the previous one. On April 9th about seventy-five members and guests sat down at the nicely laid tables in the dining room of the Commercial Hotel. It was host Henry McQueen's first banquet since he took over the popular hostelry, and he certainly left nothing undone to give his patrons a good time. The supper included the substantial and the dainty in abundance and was served in good style. The chair was occupied by Thomas Elliott, president, and among the guests were : A. M. Wickens, of Toronto, past president of the executive board ; Mayor Morden. Ald. Stewart, ex-Ald. Jas. Donald and James Gill, of the Collegiate Institute staff. The toast list was :

" The King"—National Anthem. "Canada, Our Home"—Chorus, "The Maple Leaf" ; response, Jas. Donald. " Hamilton, the Ambitious City"—Responses by Mayor Morden and Ald. Stewart. " Manufacturers"—Response by Jas. Gill. "The Executive Head"—Response by past president R. C. Pettigrew ; " Kindred Associations"—Response by past president A. M. Wickens. " The Press"—Response by W. Crockett. " The Ladies"—Responses by Robt. McPherson, H. Gottlieb and M. Sweet. " Our Host and Hostess"—Response by H. McQueen. During the evening songs were contributed by James Jardine, W. W. Hislop and J. Burdjane, H. J. Allan playing the accompaniments. Mandolin and piano music was provided by Eugene A. Rysan and Fred A. Fralick, of the Boston School of Music. The piano, a Morris, was kindly loaned by Mr. T. J. Baine. The committee in charge was composed of W. R. Cornish, past president, chairman ; Thos. Elliot, president ; John Donaldson, vice-president ; J. Ironside, secretary ; F. J. Scullhrop, Thos. Chubb, J. Kennedy and R. C. Pettigrew.

Hamilton Branch is progressive. Last November a committee of this society asked the Board of Education to open up a class in mathematics in the evenings so that young men who had to work could better their positions in that branch of work which required the use of problems, figuring horse-power of engines, etc. This class was started with Jas. Gill, B. A., as teacher. It was a great success and every person who attended improved their time. At the regular meetings of the Association work of an educational character was kept up, nearly every member taking part.

PUBLICATIONS.

We have received from the publishers, Messrs. Spon & Chamberlain, 123 Liberty Street, New York, a copy of specifications for Continuous Current Dynamo Design, which has evidently been compiled with much care. The price of single copies is 25 cents.

S. P. Thompson's latest work is entitled "Design of Dynamo." It is published by Messrs. Spon & Chamberlain, 123 Liberty street, New York, and retails at $3.50. The work is purposely confined to continuous current generators, and as it will be used by engineers chiefly in the United States, the Colonies and Great Britain, calculations and data have been expressed in inch measures. It contains upwards of 250 pages, in addition to eight large folding plates to scale, four pages for windings printed in three colors, and two large folding tables of the S. W. B. and B. & S. wire gauges.

Captain Harrison, of Winnipeg, has made a proposition to establish an electric light plant at Calgary, N. W. T.

Mr. J. Buxton, boiler inspector for the North-West Territories, held an examination recently, when the following candidates sought to obtain certificates : S. T. Hubbard, W. A. Clark, A. Allen, W. Meredith, J. J. Nichols, J. Omand, Jos. Hensdoerfer, Thos. Rattray, W. Short, J. R. Benton, G. E. Bevington, Edmonton ; R. F. Buerlin, Wm. Umbach, A. D. McDairmid, Stony Plain; Dan. McDonald, Morinville ; F. Weder, Beaver Hill ; John Baerg, Fort Saskatchewan ; W. Pullskey, Star ; L. Vanacker, St. Albert.

ALUMINUM

ELECTRICAL CONDUCTORS
FOR
RAILWAY FEEDERS AND TRANSMISSION LINES. . . .

INGOTS, SHEETS, WIRE, TUBING, CASTINGS.

Prices with full information on application.

NORTHERN ALUMINUM CO.
PITTSBURGH, PA.

SPARKS.

It is reported that Mr. Thomas McConnell, of Lindsay, Ont., will build a summer hotel on Jackson's island, in Sturgeon Lake, and that he may install an electric light plant.

The lighting contract for the city of Fredericton, N.B., expires this year, and the Council to calling for tenders for a new contract. The installation of a municipal plant is favored by some of the councillors.

A by-law will be submitted to the ratepayers of Gravenhurst, Ont., on May 11th to raise $30,000 for the purchase of the plant of the Gravenhurst Electic Light Company and for improvements and extensions thereto.

Mr. A. F. Barber has submitted a proposition to establish an electric light plant in North Vancouver, B.C. He proposes to incorporate a company under the title of the North Vancouver Light & Power Company and to charge the following rates: For each 16 c.p. light per month: Churches, 40 cents; stores, first four 66c, next six 61c, each additional light 50c; dwellings, first three 55c, next three 45c, each additional 35c; hotels, first twelve 75c, next twenty-five 55c, each additional 45c. The plant would be operated by steam at first.

The annual meeting of the shareholders of the Demarara, Electrical Company, which is controlled by Canadian capitalists, was held in Montreal on April 21st. It was shown that the profits from the operation of the company during the twelve months ended December 31st, 1902, after providing for interest on the bonds and all other charges, were $13,414.45, or 2¼ per cent. upon the share capital. During the year a new boiler, engine, alternator and railway generator were added to the equipment of the power station. The installation of this machinery has put the plant in condition to take up all the lighting and power work that may be offered and enables it to be maintained in good working order at considerably reduced cost. The company also substituted alternating enclosed arc lamps for open arc lamps in its street lighting system. The company is capitalized at $850,000 and control the lighting and tram system of the Island of Demarara.

THE WESTINGHOUSE COMPANY IN CANADA.

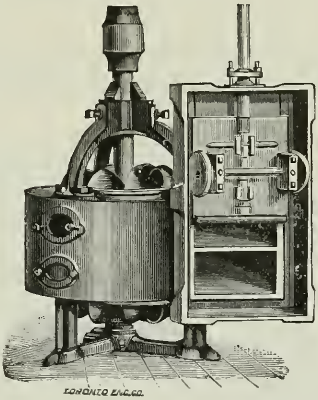
The Westinghouse Electrical & Manufacturing Company, of Pittsburg, Pa., have definitely decided to establish a factory in Canada for the purpose of manufacturing the electrical apparatus required to supply the Canadian market. It is proposed to form a Canadian Westinghouse Company and to locate the factory at Hamilton, in conjunction with that of the Westinghouse Air Brake Company now located in that city. It is understood that the company will be capitalized at $2,500,000 and that the proposed works will be of an extensive character.

It is understood that Messrs. T. Ahearn and Warren Y. Soper, of Ottawa, who have represented the Westinghouse Company in Canada for a number of years, will be members of the board of directors of the Canadian company.

The Cantin Company, Warwick, Que., have recently placed an order with J. C. Wilson & Company, Glenora, Ont., for a deep bucket 24 inch "Little Giant" water wheel.

Sole Makers of the . .
SYRACUSE BABBITT METALS
Which are the best for all machinery bearings, also wire and bar solder. We purchase scrap copper wire and brass scrap.
Syracuse Smelting Works
MONTREAL, P. Q.
Head Office American Works, 94 Gold St., New York City.

CHASE--SHAWMUT COMPANY
390 Atlantic Avenue, BOSTON, MASS.
MANUFACTURERS OF . . . . Electrical Specialties
RELIABLE DURABLE EFFICIENT ECONOMICAL
"Shawmut" Tested Fuse Wire and Links
"Shawmut" Enclosed Indicating Fuses
"Shawmut" Junction and Outlet Boxes
"Shawmut" Flexible Rail Bonds
"Shawmut" and "Monadnock" Switches
"Chase" Nipples and Flexible Conduit Couplings
"Boston" Cable Hangers
"Cushing" Theatre Switchboards
"Cushing" Stage Lighting Appliances
Switchboards and Panel Boards
Electrical Repairing


TORONTO ENG.CO.

LITTLE GIANT DOUBLE TURBINE
HORIZONTAL AND VERTICAL
Made in 44 sizes from 4 inches to 60 inches diameter, in either iron scroll case (see cut) or in flume case.
Machine dressed gearing a specialty.
Write for catalogue and gear list.
Correspondence solicited.
J. C. WILSON & CO.
GLENORA, ONT.

THE BANNER ELECTRIC COMPANY
YOUNGSTOWN, OHIO, U. S. A.
MANUFACTURERS OF : : : : :
Incandescent Electric Lamps
Combination Entrance Switches and Plug Cut-outs
Automatic Time Switches
Main Line Fuse Plugs
Terminal Lugs, etc., etc.
Everything first-class and fully guaranteed. :o: :o: :o: Inquiries solicited

MOONLIGHT SCHEDULE FOR JUNE.

Date.	Light.	Date.	Extinguish.	No. of Hours.
June 1	8 00	June 2	3 30	7 30
2	11 15	3	3 30	4 15
3	11 50	4	3 30	3 40
5	0 20	5	3 30	3 10
6	1 00	6	3 30	2 30
7	1 30	7	3 30	2 00
8	No Light	8	No Light	
9	"	9	"	
10	"	10	"	
11	8 00	11	10 00	2 00
12	8 00	12	10 45	2 45
13	8 00	13	11 20	3 20
14	8 10	14	11 50	3 40
15	8 00	16	0 30	4 20
16	8 00	17	1 00	4 50
17	8 00	18	1 30	5 20
18	8 00	19	2 00	5 50
19	8 00	20	2 30	6 20
20	8 00	21	3 10	7 00
21	8 00	22	3 30	7 20
22	8 00	23	3 30	7 20
23	8 00	24	3 30	7 20
24	8 00	25	3 30	7 20
25	8 00	26	3 30	7 20
26	8 00	27	3 30	7 20
27	8 00	28	3 30	7 20
28	8 00	29	3 30	7 20
29	8 00	30	3 30	7 20
30	8 00	July 1	3 30	7 20
		Total	....	141 50

The City Council of Guelph, Ont., are negotiating for the purchase of the electric railway of the Guelph Railway Company. The company have asked $100,000 for their plant and franchise.

Messrs. J. N. McKendry, H. L. Dunn, A. D. Crooks and Frank Denton, of Toronto, are seeking incorporation as the Niagara, Queenston and St. Catharines Electric Railway Company, to build an electric railway connecting the places named.

VINCENT

BRONZE DISCS
Outlast All Others
Therefore it Must be
ECONOMY

A COMBINATION OF GOOD POINTS.

TO USE OUR
Globe and Gate Valves

VINCENT VALVE CO.,
SANDUSKY, OHIO, U. S. A.
79 KING STREET EAST, TORONTO, ONT.

The McEwen High Speed Automatic Engine

The McEwen High Speed Automatic Engine is an honestly constructed engine.

It's honest all the way through.

Not a single item enters into its make-up but what has been tested and proven true.

For a high speed engine the McEwen is an economical engine.

Its regulation is perfect and it gives a most satisfactory service for the special purposes for which it was designed.

OUR GUARANTEE

The engine shall not run one revolution slower when fully loaded than when running empty, and a reduction of boiler pressure from the greatest to that necessary to do the work will not reduce the speed of the engine one revolution.

Any engine failing to meet this guarantee becomes the property of the purchaser upon the payment of one dollar.

For street railway service, electric lighting, electric crane work, mine haulage or any service where loads fluctuate with rapidity the McEwen is the ideal high speed engine.

Its guarantee given herewith proves our contention that the McEwen has almost perfect regulation. We should be pleased to send you the catalogue of the McEwen showing its construction embodied in its making.

THE WATEROUS ENGINE WORKS CO., Limited, Brantford, Ont.
Branches: Winnipeg and Vancouver

SPARKS.

Paris, Ont., is about to build a new electric light station.

The Bell Telephone Company are about to install a telephone system at Emerson, Man.

The Town Council of Windsor Mills, Que., will install a municipal electric light plant. A water power on the Wattcpekah River will be developed.

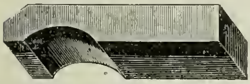
The Council of Ingersoll, Ont., have offered the Ingersoll Electric Light Company $25,000 for their plant, but the company ask $28,000.

The Winnipeg Street Railway Company have voluntarily increased the wages of their motormen and conductors. The scale now ranges from 17 to 21 cents per hour according to the length of service.

The Stewart Machinery Company, Limited, of Winnipeg, were the successful tenderers for the installation of an electric light plant for the town of Prince Albert, N. W. T., their price being $9,700.

The bill to incorporate the Aluminum Production Company of New Brunswick, Limited, is now before the Provincial Legislature. The capital of the company is $6,000,000. It is proposed to manufacture aluminum and to locate the works in Queens County. Messrs. James Robinson, M.P., James Domville and Charles J. Foster, of St. John, N. B., are the provisional directors.

SWEDISH CHARCOAL IRON SHEETS, BARS, RODS, STRIPS AND STAMPINGS.



Magnet Forgings, Slabs, Bars in the Rough and Machined.

TURNER BROS., 134 UPPER THAMES ST., LONDON, ENG.

Telegraphic Address, 'SHEETIRON', LONDON. ESTABLISHED 1870.

Discs over 5 feet diameter and Plain Circles
Sheets up to 66 in wide.

MILD STEEL CASTINGS FOR MAGNETS

MAGNET STEEL FOR TELEPHONES

Sole Representatives for Canada: Peacock Brothers, Canada Life Buildings, Montreal.

BARGAINS

Owing to reconstruction of plant, a large amount of electrical apparatus will be sold cheap —A. C. Generators, 1,200 volts, 16,000 alternations; 80 to 250 K.W. Exciters; 250 volt D.C. Generators; Switches; Switchboard Voltmeters and Ammeters; Station Transformers; Belting; Iron and Wooden Pulleys, all sizes; Shafting, 3 to 6 inches; Floor Stands and Boxes; Couplings; Frictions and other things too numerous to mention. Mostly in first-class condition.

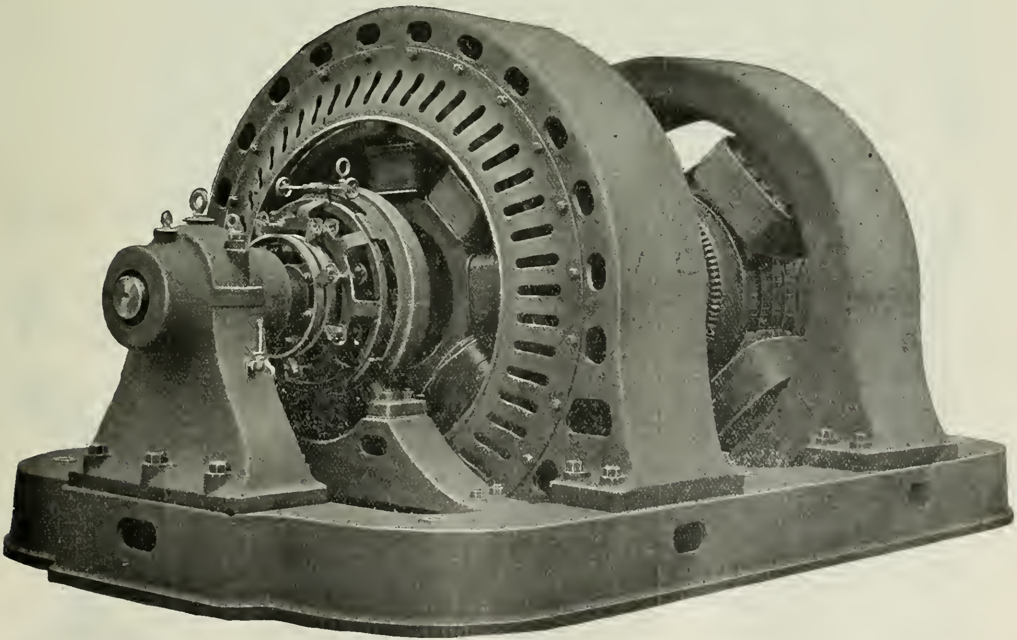
Address, BARGAINS, this office, and full particulars will be furnished.

THE
"TRITON"
—MARINE—
Gasoline Engine
Simplest, Safest and Most Reliable.

Hamilton Motor Works
Hamilton, Canada.
258 Catharine Street North.

"Engines in successful operation from Halifax to Vancouver."

Dick, Kerr & Company
LIMITED



Head Office: 110 Cannon Street, LONDON, E. C, ENGLAND
Canadian Agent's Office: 332 King Street, KINGSTON, ONT.

SPARKS.

J. C. Wilson & Company, Glenora, Ont., have recently executed for the Northey Company, Toronto, Ont., an order for a pair of heavy iron spur pump gears, finished with machine dressed teeth.

The City of Winnipeg invites proposals up to May 25th for the supply of electric power. The maximum quantity to be used at any time is placed at 1,000 horse power and the minimum at 250 horse power.

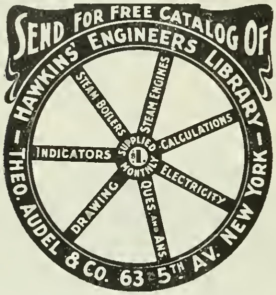
The plant of the Northey Company, manufacturers of steam and gasoline engines, pumping machinery, etc., Toronto, has been removed to the new works of the Canada Foundry Company on Davenport Road. The Northey Company is now controlled by the Canadian General Electric Company.

Mr. George Kidd, of Ottawa, has applied for the incorporation of the Canadian Telegraph & Telephone Company. M. Kidd states that the object of the company is to inaugurate and develop a telephone and telegraph system across the Continent, and that the incorporators are American and Canadian capitalists. In addition to telephone and telegraph powers, the incorporators ask for the right to generate and transmit electricity.

The Algoma Electric Company are reported to have taken the contract for wiring a large number of houses at Blind River, Ont., also for the installation of arc lights on the streets.

Judgment was given last month in the long-pending suit of Mr. P. H. Patriarche, of Toronto, against the town of Orillia and Mr. Peter Ryan, arising out of the construction of the Ragged Rapids power plant. The plaintiff's claim involved a total of $112,000. The judge dismissed the claim as presented, but pointed out that should the plaintiff choose to amend his claim and bring it within the terms of the contract found by the court to exist among the parties, he could have $99,275.75. As the town has paid him $46,729.66 he is entitled to receive $42,546.09 with $2,127.30 interest added. Mr. Peter Ryan was allowed his costs. After hearing the judgment Mr. Patriarche announced his intention to appeal.

MICA & ROCK DRILLS
Miners and exporters of Electrical Mica, and sole agents for **Jackson Hand Power Rock Drill** and **Box Electric Rock Drill** for Canada.
JOHNSON, WILLATS & CO., 192 King Street West, TORONTO.



TRADE WITH ENGLAND

Every Canadian who wishes to trade successfully with the Old Country should read

"Commercial Intelligence"

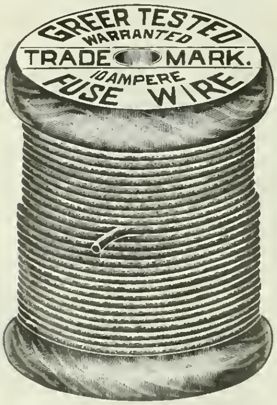
The address is 166, Fleet, London, Eng.

The cost is only 3d. per week including postage.

(Annual Subscription 20 Shillings.)

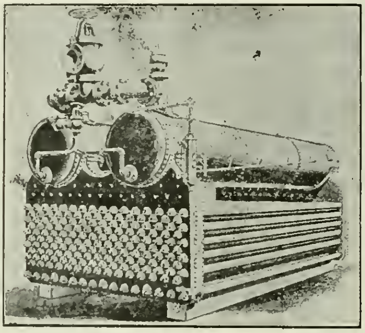
Moreover, regular subscribers are allowed to advertise without charge in the paper—See the rules.

Greer Tested Fuse Wire



EACH SPOOL IS PACKED IN A STRONG TIN BOX.
Full weight guaranteed to each spool.
Warranted to be absolutely uniform, reliable and accurate. Send for catalog.

HARVARD ELECTRIC CO.,
224-226 South Clinton Street
CHICAGO, ILL.


THE CANADIAN HEINE SAFETY BOILER CO.
JOHN J. MAIN, President and Manager.
Esplanade, Opp. Sherbourne St., Toronto
HIGH CLASS

Water Tube Steam Boilers

for all pressures, duties and fuel. From 75 to 600 h. p. each. N. B.—We do not make small boilers.

REFERENCES :—The Toronto Electric Light Co, Limited ; The T Eaton Co. Limited ; The Massey-Harris Co., Limited, The Gutta Percha Rubber & Mfg. Co, Dominion Radiator Co., Central Prison, Foresters' Temple, Toronto City Hall, where boilers may be seen working.

RECENTLY PUBLISHED

THE CANADIAN HAND-BOOK OF STEAM AND ELECTRICITY

BY WILLIAM THOPSON

170 Pages, Illustrated In Strong Cloth Binding

THE preparatory chapters are devoted to a concise explanation of the foundation principles of Mathematics, a knowledge of which is absolutely necessary to the study of Electricity and Engineering. In the succeeding chapters the student is led by gradual stages to a more complete acquaintance with these subjects, and is equipped with knowledge to enable him to pursue his researches to any further extent.

PRICE 50 CENTS

The C. H. Mortimer Publishing Company, of Toronto, Limited
TORONTO, - CANADA
SEND FOR TABLE OF CONTENTS.

TELEPHONES

We manufacture TELEPHONES for all kinds of service; Central, Exchange, Factory, Warehouse, etc. Our

DESK TELEPHONE

as illustrated is a handsome instrument, perfect in construction and design, with no exposed contacts or wires, and has many other points of advantage.

Fully guaranteed and sold on merit.

Send for our new Telephone Catalogue.

John Starr, Son & Co., Limited
P. O. Box 448 - *HALIFAX, N. S.*

CANADIAN

ELECTRICAL NEWS

AND

ENGINEERING JOURNAL

Vol. XIII. JUNE, 1903 No. 6.

King Edward Hotel, Toronto.
HEADQUARTERS FOR THE C. E.A. CONVENTION, JUNE 10th, 11th and 12th.
[See Programme on Following Page.]

CONVENTION PROGRAMME

CONVENTION HEADQUARTERS—KING EDWARD HOTEL, TORONTO.

WEDNESDAY, JUNE 10.

10 A. M.—Meeting of Executive Committee.

11 A. M.—Opening of Convention in Assembly Hall, King Edward Hotel.

Address of Welcome by the Mayor of Toronto.

President's Address.

Reading of Minutes.

Reports of Secretary-Treasurer and Committees.

General Business.

Paper: **"Long Distance Transmission."**
By Mr. Paul Lincoln, Pittsburg, Pa.

Question Box.

THURSDAY, JUNE 11.

10 A.M.—Papers:

"Individual Electric Drive and its Relation to the New Shop Methods."
By Mr. R. T. Lozier, Cincinnati, O.

"Some Points Relating to Submarine Power Cables."
By Mr. G. U. G. Holman, Quebec

2 P.M.—Papers:

"Single Phase Alternating Motors as a Means of Increasing Station Earnings."
By Mr. W. A. Layman, St. Louis, Mo.

"Transformers for High Voltage Transmission Lines."
By Mr. J. W. Farley

Question Box.

General Business.

FRIDAY, JUNE 12.

Selection of Place of Next Meeting.

Election of Officers.

Unfinished Business.

SOCIAL FEATURES

WEDNESDAY, JUNE 10th. 4 P. M.—Tally-Ho drive to points of interest in the City, by courtesy of Canadian General Electric Co.

8 P. M.—Excursion by special steamer and Band Concert at Toronto Island.

THURSDAY, JUNE 11th. 4 P. M.—Visit by special cars to the works of the Canada Foundry Co., by courtesy of the Company.

9 P. M.—Annual Association Dinner, King Edward Hotel.

TRANSPORTATION AND HOTELS.

Persons attending this Convention should purchase a full fare one way ticket to Toronto, and get from the ticket agent from whom they buy a certificate of purchase. This certificate when signed by the Secretary of the Association will entitle them to return at one-third fare over the G.T.R. or C.P.R.

For persons attending the Convention who may desire before returning home to visit Niagara Falls, a special return rate of $1.25 has been granted by the Niagara Navigation Co., GOOD FOR SATURDAY THE 13th INST. ONLY. Tickets must be purchased at the head office of the Company, 54 King Street East, Toronto. Special permission to inspect the power development works at Niagara Falls, Ont., has been arranged for.

The management of the King Edward Hotel, which will be Convention Headquarters, have granted a special rate of $1.50 per day and upwards, European Plan, and $3.00 per day and upwards, American Plan.

Seven years ago the City of Toronto was, for the second time, honored by a convention of the Canadian Electrical Association. On June 10th, 11th and 12th next that honor will be repeated. In the intervening time the Association has grown to be a much larger and more important body. That the electrical fraternity and citizens of Toronto will fittingly welcome and entertain the visitors on the occasion of this convention may be taken for granted, for Toronto, besides being the Queen City of the West, may also be termed the "Convention City."

If to the interesting programme of business and social features which have been provided, are added the many attractions possessed by the Provincial Capital every possible inducement to a large attendance would seem to have been secured. In anticipation of the largest attendance on record, the local committee, under the chairmanship of Mr. A. B. Smith, are rapidly concluding arrangements which will ensure to all members and visitors a pleasurable and profitable gathering. The scope of the papers to be presented is such as should interest all branches of the electrical industry. The banquet to be held in the magnificent new King Edward Hotel will be a brilliant event, and any of the members who may not attend will miss a golden opportunity of broadening their knowledge and business and social connection.

From whatever point the city of Toronto is viewed, it presents elements of attractiveness. The streets are broad and splendidly paved; the residences and public buildings are as fine as can be found in any city of its size in America; there are several spacious and picturesque parks; and what is of great importance, an electric street railway system second to none in America, of which particulars are given elsewhere in this issue.

The two principal public buildings are the Parliament Buildings in the Queen's Park, and the City Hall.

The semi-public buildings of the first rank include the University of Toronto, located to the west of the Queen's Park, Osgoode Hall on Queen street west, McMaster Hall on Bloor street, Upper Canada College at the head of Avenue Road, the Normal School on Church street, School of Practical Science on College street, in addition to many others of lesser importance.

The new King Edward Hotel, which will be the Convention Headquarters, has just been opened. Erected at a cost exceeding one million dollars, it is beyond doubt the most palatial and handsome hostelry in Canada, and excelled by few in the United States. The equipment is of the finest and includes a private telephone system and an electric light plant, of which an illustration is shown on another page.

Mr. B. F. Reesor,
President Canadian Electrical Association.

The absence of water power in the immediate vicinity of Toronto is responsible for the employment of electricity to a lesser extent than in many other cities of equal commercial importance. This, however, promises to be remedied in the near future by the introduction of electric power from Niagara, when there will doubtless be a rapid growth in the number of motors used by manufacturing concerns. The lighting business in Toronto, on the other hand, is very large and is supplied by the Toronto Electric Light Company and the Incandescent Light Company from steam-driven plants. There are also a number of isolated electric plants throughout the city, some of which are described in this number.

OFFICES OF THE CANADIAN GENERAL ELECTRIC COMPANY.

The offices of the Canadian General Electric Company occupy the entire building, Nos. 14 and 16 King street east, Toronto, and are conveniently situated in the centre of the business district of the city. The building is a four-storey one, with a total floor space of over 25,000 square feet. It is equipped throughout with modern facilities and a completeness of detail particularly suitable for enabling the company to meet the growing demand and better serve the wants of their customers throughout the Dominion.

On the ground floor are situated the general manager's office, board room, offices of the executive officials, and the general offices.

Mr. J. W. Campbell,
Chairman Dinner Committee C. E. A. Convention.

On the first floor is a nicely arranged show room and a display of samples representing a wide range of electric light, power and railway material, and general supplies, including switchboards, station and portable measuring instruments, motors, transformers, enclosed arc lamps, fan motors, electric cooking and heating appliances, and numerous other devices, many of which are shown in operation. Those who are directly or indirectly connected with the electrical industry will find a visit to this show room of much interest.

The warehouse is also located upon the first floor and includes the second floor and basement, with a total floor area of about 17,000 square feet. A large and well assorted stock of staple supplies and material is carried. Each floor of this department is connected by a private warehouse telephone system.

The third floor is occupied by the agency department, and the business and executive offices of the Canada Foundry Company, Limited, which is controlled by the Canadian General Electric Company. The fourth floor is occupied by the engineering staff and is laid out in general offices, drafting, designing and testing departments.

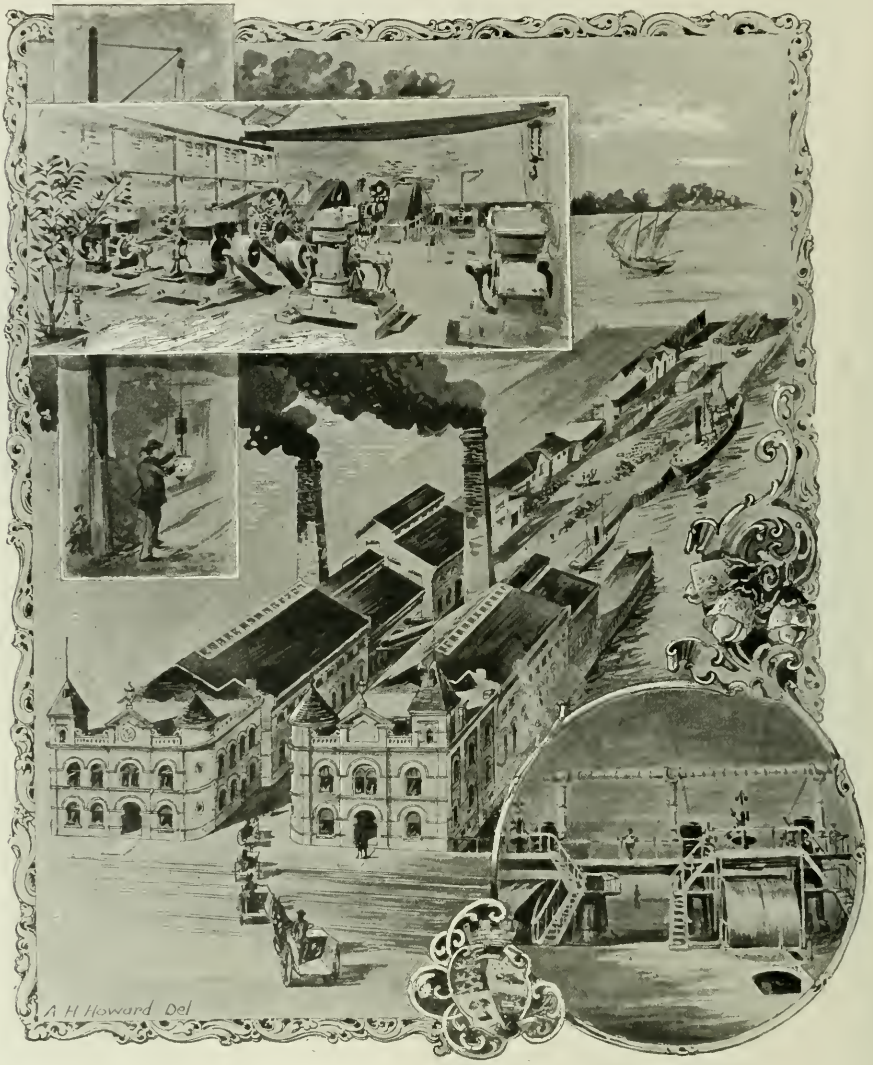
All of the different departments and floors are rendered easy of access by means of electric passenger elevators. Among other salient features of the establishment may be mentioned a local telephone system with a central office in the building, thus enabling every department to have direct communication with each other as well as to outside points. A long distance telephone and two telegraph offices (the company having its private wires to the works at Peterboro and at Davenport) are also conveniently located in the general offices.

We might go on indefinitely dealing with the innumerable details which go to make up the many valuable appurtenances and conveniences of these offices. Mention might be made, however, of the fact that most of the building is lighted by C. G. E. 5-ampere direct current enclosed arc lamps. This system, which is generally conceded to be one of the best means of artificial lighting, is most satisfactory.

Land has been purchased for new offices and show rooms to be constructed at the corner of King and Simcoe streets. The plans show a commodious and handsome building in keeping with the progressive policy of the company.

TORONTO ELECTRIC LIGHT COMPANY.

The power house of the Toronto Electric Light Company, at foot of Scott street, is second to none in Canada. Upon the destruction by fire of the arc lighting station in February, 1897, steps were taken to rebuild this portion, as well as to improve the entire plant, the result being that modern fire-proof structures, equipped with up-to-date apparatus for arc and incandescent lighting and for power, are now to be found.



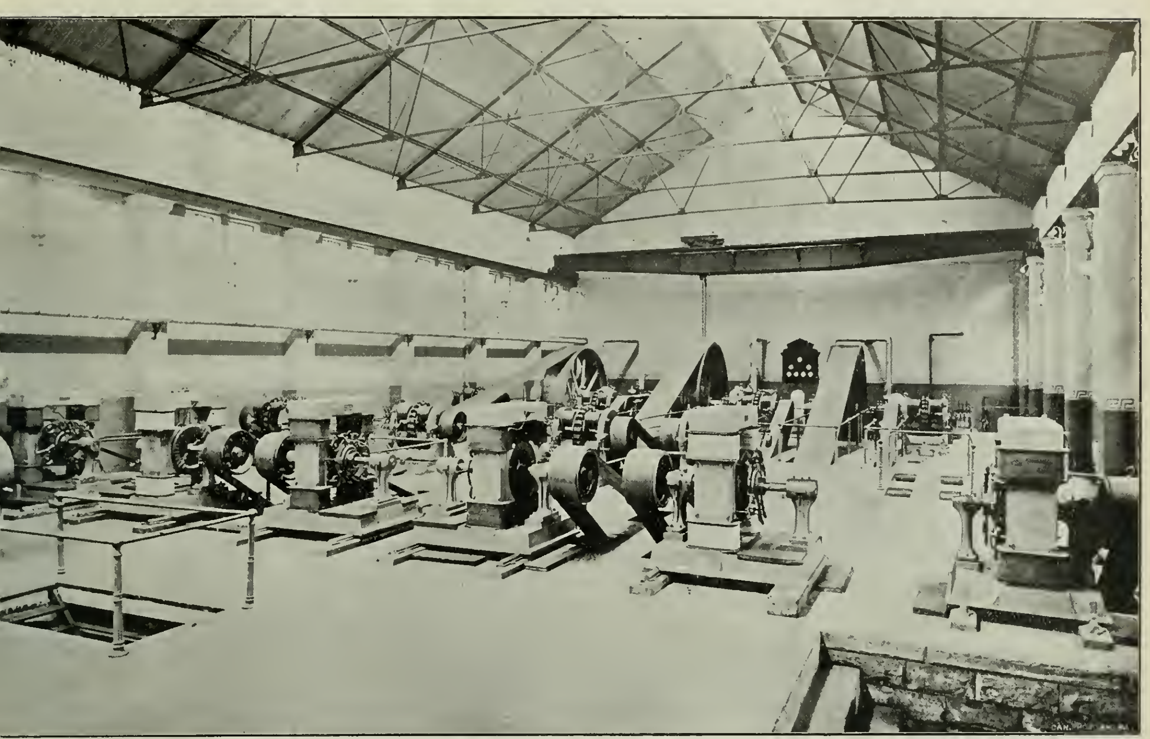
Toronto Electric Light Company—General View of Works.

The illustrations which we present are from photographs taken upon the completion of the reconstruction in the spring of 1898, since which time large additions have been made both to buildings and plant. The foundations of the buildings are of stone and concrete, and the superstructure largely of steel. There is absolutely no wood or any combustible substance used in any part of the construction. The works cover an area of 20,000 square feet and are located on the water front, rendering a supply of coal easily obtainable.

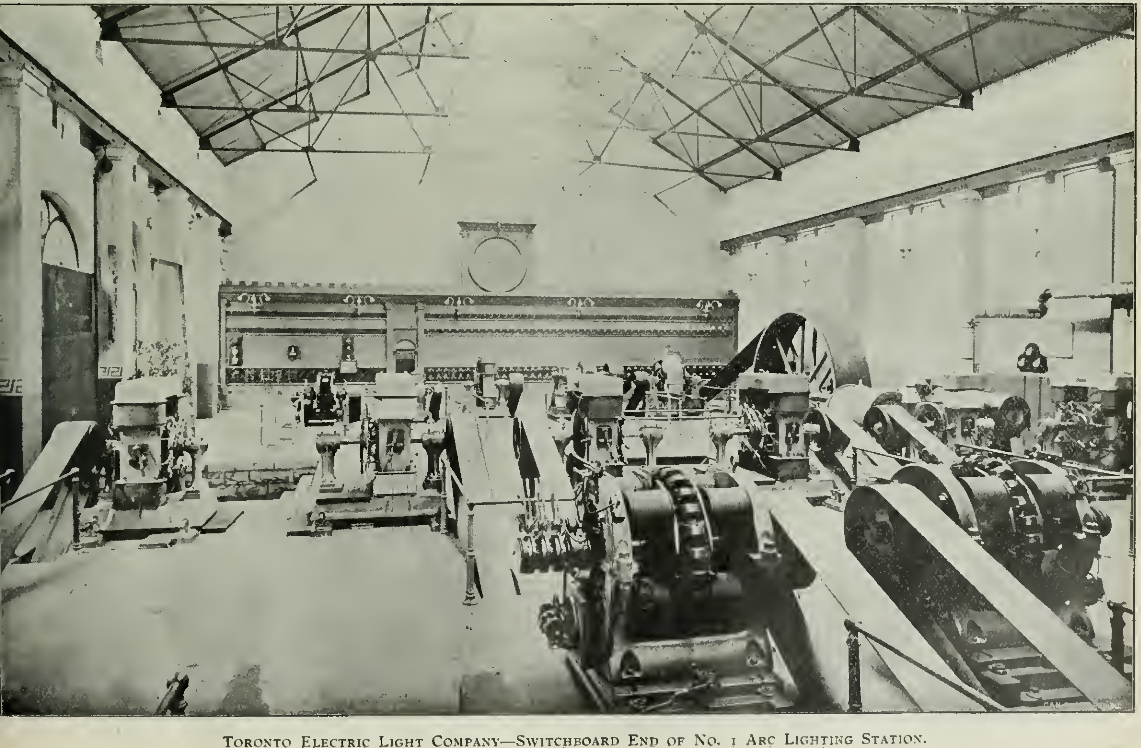
The foundations for machines consist of solid beds of concrete about three feet in thickness. The shafting throughout the works is all extremely heavy and runs in self-oiling bearings of the latest designs.

Arc light station No. 1 is illustrated by photographs taken of each end from the centre of the building. The machines include eight Brush arc dynamos of 125 lights each, and eight of 125 lights each and six of 35 lights each of the Toronto Electric Light Company's own make.

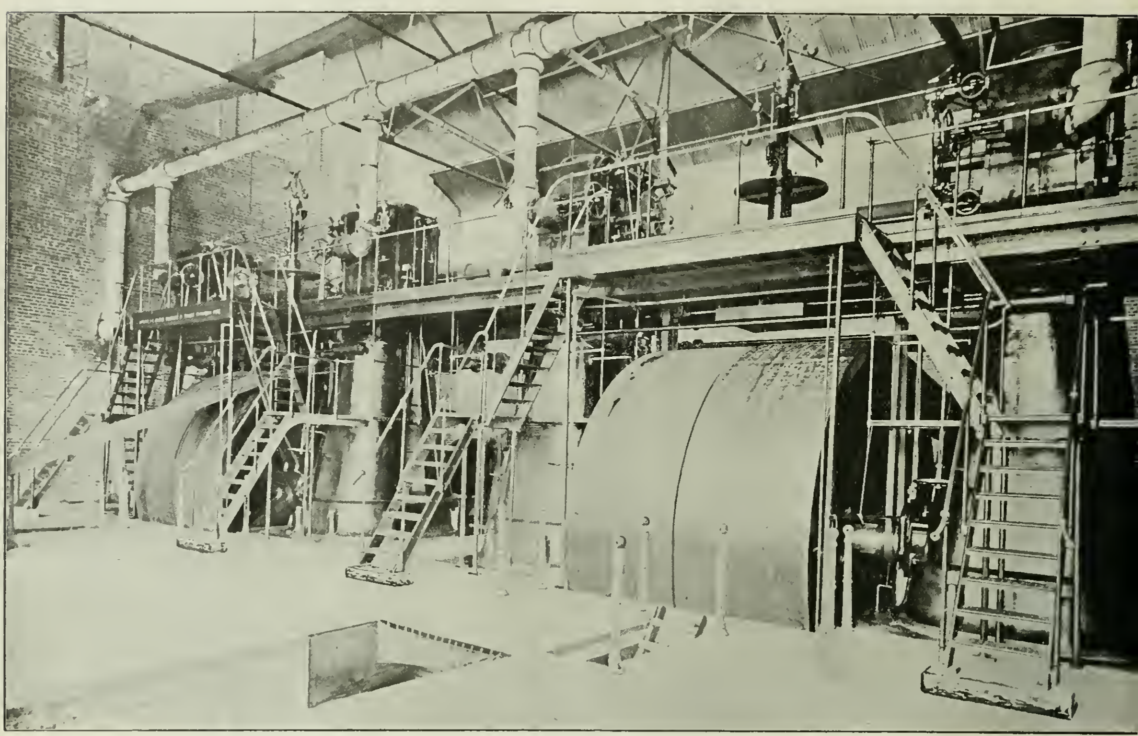
At one end of the station will be seen the arc light switchboard, which is built of pressed brick with terracotta trimmings and is surmounted by a clock driven by electricity. Each arc circuit has ampere meters on the face of the switchboard large enough to be seen from any part of the room, and behind the wall there is a slate shelf for standard ammeters, which can be



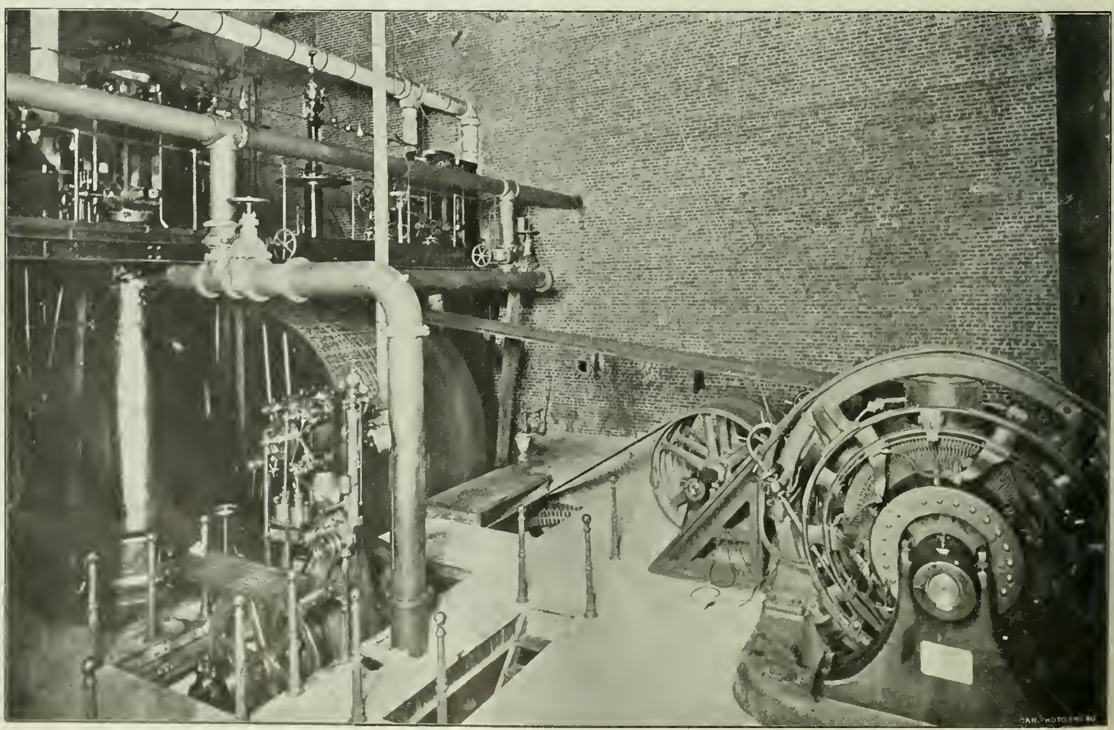
Toronto Electric Light Company—Engine End of No. 1 Arc Lighting Station.



Toronto Electric Light Company—Switchboard End of No. 1 Arc Lighting Station.



Toronto Electric Light Company—3,000 h.p. Engines in No. 3 Station.



Toronto Electric Light Company—Direct Current Generator, 250 Volts, 500 K. W.

plugged into any circuit desired, and also polarity indicators to ensure the currents flowing in the proper direction.

In addition to the equipment herewith illustrated, there was installed in No. 1 station two C. G.E. multipolar power generators of 500 k.w. each and two of 100 k.w. each.

Station No. 2 contains a double-tandem upright Corliss engine of 1,000 horse power capacity, with a fly wheel of 60 inches base, and the general distributing switchboard for all the output of current for power and incandescent lighting purposes. There are now being installed a Robb-Armstrong engine of 550 horse power, to be direct connected to a 500 k.w. Canadian General Electric multipolar power machine.

Station No. 3, as illustrated, is equipped with two pairs of upright Corliss engines of 1,000 h.p. each, and four dynamos—two of 500 k.w. capacity, 250 volts, for motive power purposes, and two alternators of 450 k.w. capacity each, all of the C.G.E. make. The last illustration shows a direct current generator. In this view may be seen one of the automatic cut-off air pumps and condensers which are used throughout the installation. Within the past three years, the equipment of this station has been considerably enlarged. In the fall of 1901 there was installed another engine of 1,500 horse power capacity, manufactured by the Polson Company, of Toronto. This engine was put in operation just in time to take care of the heavy load incident to the visit of the Duke of York, and for that reason is called the "Duke of York". It is of the vertical type and weighs about 200 tons, the fly wheel alone weighing forty tons. The cylinders are 56 inches in diameter. The bearings throughout are water-jacketed, thus insuring coolness in operation. The engine is connected to a 500 k.w. C.G.E. multipolar generator and a 450 k.w. C.G.E. alternating generator. In addition there are now in course of installation in No. 3 station two Polson engines of 550 horse power each, to be direct connected to a 500 k.w. multipolar generator and a 400 k.w. alternator of the same make.

Toronto Electric Light Company —Office Building.

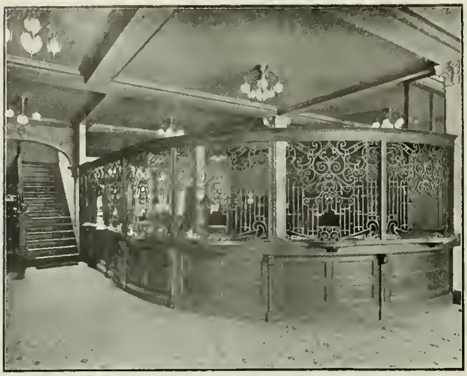
The additional power required has made it necessary to extend the boiler house. This is now being done, the intention being to install boilers of 2,500 horse power capacity from the works of the Canadian Heine Boiler Company, Toronto. A new smoke stack is also under construction. The company manufacture their own arc lamps, switchboards and instruments, having a large machine shop for the purpose.

Mr. J. J. Wright,
Manager Toronto Electric Light Company,

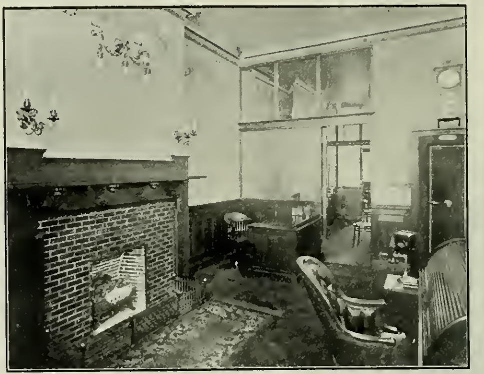
The company recently erected a splendid up-town office building at 12 and 14 Adelaide street east. It is a four-storey brick and stone structure, with a frontage of 51 feet and a depth of 140 feet. This building contains the general offices of the company, the meter department, and show-rooms. It is spacious and nicely fitted up, and is probably the finest building of its kind in Canada. The office of the general manager located to the left of the entrance, and that of the secretary to the right. The show rooms on the second floor are beautifully furnished, the stock carried including a range of electric and combination gas and electric fixtures of handsome design.

Mr. W. A. Martin,
Secretary Toronto Electric Light Company.

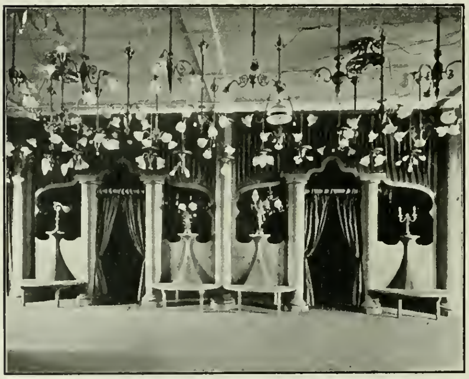
The general manager of the company is Mr. J. J. Wright, and the secretary Mr. W. A Martin. Both the power house and the office building of the company are of a very interesting character and would well repay a visit by anyone interested in such matters. The officials always extend a cordial welcome to visitors.



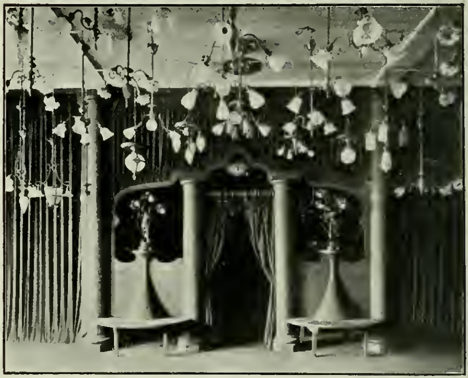
General Office.



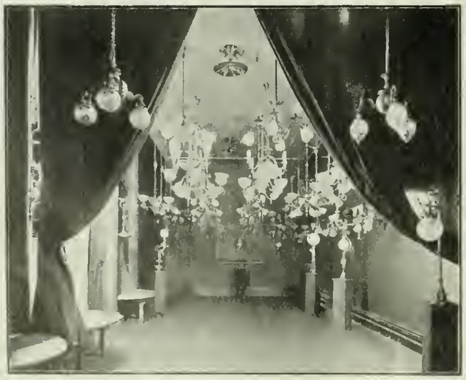
General Manager's Office.



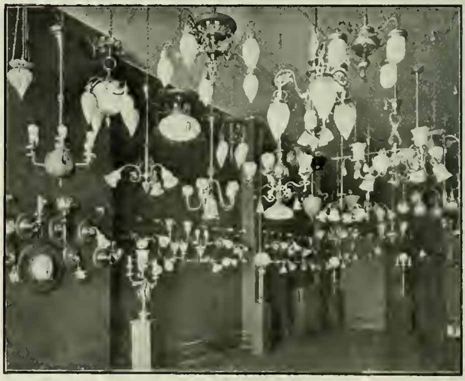
Main Showroom.



Main Showroom.



Combination Showroom.



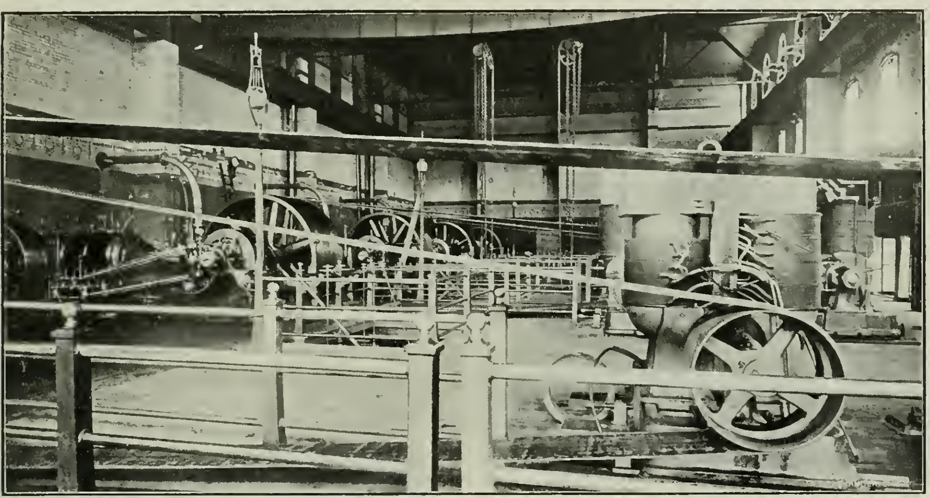
Ceiling Lights Showroom.

VIEWS IN THE OFFICES AND SHOWROOMS OF THE TORONTO ELECTRIC LIGHT COMPANY.

THE TORONTO STREET RAILWAY.

In few cities of America can there be found a more complete and satisfactory railway system than that which has been provided for the citizens of Toronto. One of the first in Canada to be converted into an electric road, it has been steadily improved from year to year, until to-day it stands almost pre-eminent among the electric roads of the continent. The franchise is held by the Toronto Railway Company, of which the officers are : President, William Mackenzie ; vice-president, James Ross ; general manager, E. H. Keating ; superintendent, James Gunn; comptroller, J. M. Smith; assistant superintendent, Ewen Mackenzie ; secretary-treasurer, J. C. Grace.

The power house is a brick and stone structure located at the junction of Frederick and Front streets. What is designated as power house No. 1, which contains the original installation, is 137x122 feet, and is divided from power house No. 2 by an 18-inch brick wall with iron doors.



Toronto Railway Company—Engine Room of No. 1 Power House.

POWER HOUSE NO. 1.

The boiler room in power house No. 1 has a trussed roof, leaving it free from post or pillars of any kind. The roof is 52 feet from the floor. The steam equipment consists of twelve 72-in. x 18 ft. boilers, made by the Polson Iron Works, of Toronto, and containing seventy-two 4-in. tubes each. Feed water is taken from the hot well of No. 2 engine room, at the condensers.

The engine room has also a trussed roof, with ceiling 44 feet high. The power equipment consists of four Armington & Sims engines of 500 h. p. each and one of 400 h. p. The four first mentioned were especially manufactured for this plant and have each two driving wheels 25-in. x 9 ft. placed between the high and the low pressure cylinders. The engines are so piped that they can be run non-condensing, and while in this condition with the load on can be connected with the condensers without stopping or throwing off any load. The condensers take water through a 30-in. steel pipe from the lake, a distance of 620 feet.

The engines are connected, by means of leather belts, with nine 200 k. w. Edison generators. All the cabling and wiring is taken down through the floor and carried separately to the switch-board. The latter has an ornamental front. The frame is of wrought iron and the facing of enamelled slate slabs finished in polished cherry. The ampere meters are of the Edison type and the volt meters and circuit-breakers of the Westinghouse type. Each feeder has an ampere circuit-breaker and a two-way switch used for high and low pressure in cases of emergency. Below the switch-board in the basement is a tank lightning arrester. Each of the eleven feeders at the point of entrance to the building is also protected with a Wason four-fuse lightning arrester.

The generators are placed upon very heavy cast-iron arches supported on brick walls beneath the floor of the power house and are insulated by eight inches of wood flooring.

POWER HOUSE NO. 2.

In size and construction No. 2 power house is a duplicate of No. 1. It contains the machinery of more recent installation which became necessary on account of the demand for increased power. The boiler room contains six Scotch marine boilers nine feet nine inches in diameter and 14 feet in length, of 400 horse power each, equipped with Green economizers, two Scotch marine boilers of ten feet four inches diameter and eighteen inches long, of 500 horse power capacity each, and two Babcock & Wilcox boilers of 350 h. p. each, all equipped with Jones underfeed stokers. The engine equipment consists of four cross-compound Corliss engines of 1,200 indicated horse-power each. One of these was supplied by the Laurie Engine Company, of Montreal, and the other three by the Bertram Engine Works Company, of Toronto. They drive two generators of 850 k. w. each, and two of 800 k. w. each, three of which were supplied by the Canadian General Electric Company, of Toronto, and one by the Siemens & Halske Company, of Chicago. The switch-board is equipped with four 2,500 ampere automatic circuit-breakers for controlling the generators, three 5,000 ampere meters which show the total output of the power house, connected to heavy bus-bars, and automatic switches for each cable connection on to the street, also one 10,000 ampere C. G. E. watt-meter.

OTHER BUILDINGS.

Adjoining the power house is the motor shop, 228x 105 feet, with tracks running through from Sherbourne to Frederick streets. The tracks are fitted with the necessary pits, etc., for their entire length. The armature room, 26x228 feet, is located on the second floor, also the drafting room 26x30 feet. The machine shop 50x60 feet, and blacksmith's shop 40x50 feet, adjoin the motor shop. There is also a brass foundry and moulding shop in conjunction with the motor shop buildings.

The buildings are heated by the Sturtevant fan system of forced draft, the necessary apparatus for same occupying a space 16x20 feet. Car barns across the street are also heated from this plant by means of underground pipes.

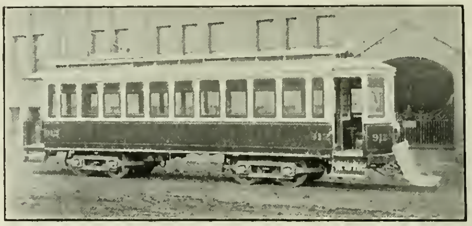
The company has eight large car barns; three are situated on King street east, one being of brick, two storeys, 224x194 feet, and the other two of galvanized iron and wood, their dimensions being 626x66 feet and 320x66 feet. At Yorkville are situated two barns, one being 242x100 feet and of brick, and the other 200x 98 feet and of galvanized iron and timber. Another barn is located at the corner of Dundas street and Howard Park avenue. It is a brick structure, 398x 100 feet. The seventh is located on Roncesvalles avenue, just north of Queen street, and is of brick, 263 x139 feet. A building east of the power house, 268x 68 feet, and three storeys high, is used jointly for storing cars and as a general store room. The lower flat of the car building shops, a three storey building 137x 108 feet, at the corner of Front and Frederick streets, may also be used for storing cars, the two upper storeys being for car building purposes.

Toronto Railway Company—Power House.

About one year ago the stores department was moved into a new building specially fitted up for the purpose. This department is a striking example of convenience and neatness and may be said to be a model storeroom for street railway purposes.

ROLLING STOCK.

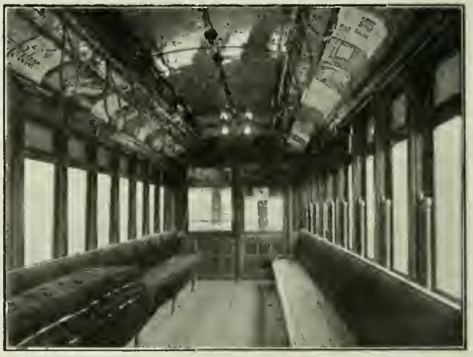
The rolling stock owned by the company comprises 296 closed motor cars, 260 of which are equipped with two-motor equipments and 36 with four-motor equipments, 196 open motor cars, with 98 closed trailers and 120 open trailers. Some of these cars are equipped with the Momentum brake. The company also operates the Toronto & Mimico Electric Railway, which has three double truck closed cars and four large open cars with a seating capacity each for 108 persons. The Scarboro Electric Railway is also operated by the Toronto Railway Company. Its rolling stock consists of four closed single truck cars with double motor equipment, and three open, single truck cars with double motor equipment.



Toronto Railway Company—New Convertible Car.

The company have in operation on the Belt Line a new convertible car. It is designated No. 912, and can be converted from a closed to an open car and vice-versa in less than one hour.

The first illustration shows the side of the car on which the panels are taken out in order to convert it into an open car. It should be stated that all the cars of the Toronto Railway Company run in one direction, not being double enders. The interior view shows the cushions removed from one of the longitudinal seats, which are in sections so that the same seats can be used when converted to an open car. The management point with pride to this car, which, they claim, possesses many points of superiority over the convertible cars in use in American cities. The company intend constructing a number of cars of this description at once.



Toronto Railway Company—Interior New Convertible Car.

The company have in operation within the city limits a total of 100 miles of track, while the Mimico road is six miles in length and the Scarboro road five miles. Of the city trackage 80 miles are laid on concrete and ties, 15 miles on concrete and tie bars without ties, and the balance on gravel with ties, but without concrete. Standard 73-pound rails are used throughout.

During the past year the company cast-welded the rails on Church street, from King to Bloor streets, making in all a distance of over two miles. They are at present laying new tracks on Front street, from Simcoe to Bathurst and to King street, making a distance of 1¼ miles of single track, the New York standard 90-pound girder rail laid on concrete, with tie bars, being used. This track will have cast joints instead of fish plates and bonds. Preparations are also being made to renew the present tracks on Yonge street, from Front to Queen streets, using the 90-pound New York standard rail above referred to. The company are also engaged in putting on 5,000 cast-welded joints on the tracks on different streets, to overcome the loss of current through insufficient bonding of joints. This system of welding joints has been found most economical. The records of the company show that on cast welded joints, properly installed, the resistance across 17 inches of the joint is only equal to the resistance of 14 inches of solid rail.

Mr. Wm. Mackenzie,
President Toronto Railway Company.

Mr. E. H. Keating,
Manager Toronto Street Railway.

The overhead construction is now of the best possible character. Within the last six months the overhead system has been largely remodelled and especially at intersections, where there have been installed switch pans and diamond crosses and frogs. There has also been adopted a new style of feed-in ears from the cables to the trolley wire, while equalizing spans between the trolley wires have been put on at stated distances throughout the entire system. This has much improved the overhead work.

In the centre of the city wooden poles are rapidly being replaced by standard iron poles, which improve the appearance of the street construction very much.

A staff of five men is employed on emergency calls, and when it is stated that for the past four months these calls have not averaged one a day, the efficiency of the street plant will be understood. There is also a regular repair staff of three men on a tower wagon constantly keeping the overhead work in repair, whilst the new work is attended to by four men and a tower wagon, all under the supervision of one foreman.

The employees of the company number about 1,300.

Mr. Jas. W. Gunn,
Superintendent Toronto Street Railway.

During the year 1902 over 44,000,000 passengers were carried and 16,000,000 transfers given.

The head office of the company is situated at the corner of Church and King streets.

COST OF SUPERHEATED STEAM.

The cost of a superheated steam plant was referred to as follows by Mr. R. Lenke in a paper on superheated steam read before the International Engineering Congress at Glasgow. Steam engines with superheated steam, he said, use on an average 30 to 40 per cent. less steam than engines of the same type using saturated steam. Consequently, boilers could be made 30 per cent. smaller, and the difference in price would nearly cover the cost of the superheater. For the same steam consumption the superheated steam engine was the cheaper, as it could be worked with a lower boiler pressure; instead of a compound engine with saturated steam, a single cylinder engine with superheated steam could be used. He called attention to the fact that superheated steam can travel at 30 to 40 per cent. higher speed through steam ports than saturated steam, which consequently means smaller steam pipes throughout.

Thornbury, Ont., has carried a by-law granting a loan towards the establishment of a gasoline engine and foundry works.

The city council of Montreal have appointed a committee to report upon a proposition to place all telegraph, telephone and electric light wires underground in one common conduit.

THE METROPOLITAN ELECTRIC RAILWAY.

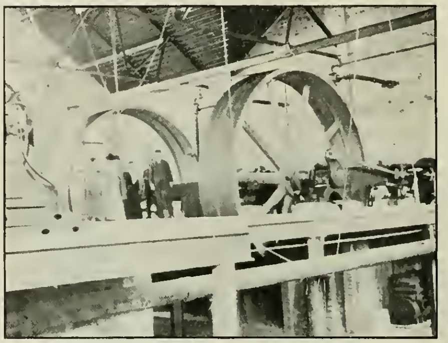
The power plant of the Metropolitan Railway Company furnishes the only example of double current generators and rotary converters to be found in Toronto or vicinity. The road extends from the C. P. R. tracks at North Toronto to Newmarket, a distance of 30 miles, passing through a number of small villages. The power house is located at Bond Lake, about 20 miles from the southern terminus of the road. It is located in a valley, the top of the building being but a few feet above the level of the land, thus providing an easy means of obtaining a supply of water for condensing purposes without the necessity of pumping.

Mr. J. W. Moyes,
Manager Metropolitan Railway.

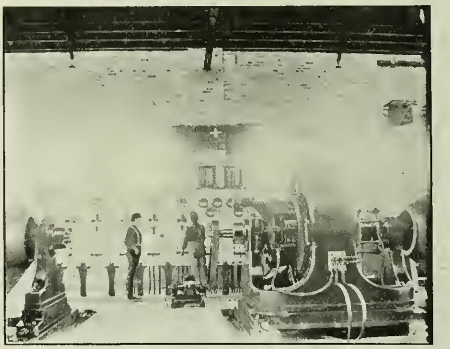
The power house is a white brick structure, with stone foundation and iron and slate roof. The boiler room is situated directly to the south of the engine room and is separated therefrom by a brick wall.

The boiler plant consists of four steel return tubulars of the Goldie & McCulloch Company's make, their combined capacity being 700 horse power. Water is fed to the boilers by two duplex boiler feed pumps manufactured by the Northey Company.

The engine equipment consists of two cross-compound Wheelock condensing engines, furnished by the Goldie & McCulloch Company. They have a capacity of 350 h. p. each operating at 86 revolutions per minute. Each engine drives a 275 k. w. A. C. D. C. 60-cycle, three-phase multipolar generator connected by means of a 42-inch belt. The generators operating at 600 r. p. m. give 550 volts direct current on one side and 350 volts alternating current on the other. The direct current is turned on to the entire length of raad, and duringthe times of trouble through falling trees, twigs, etc., the entire line is operated by direct current from the Bond Lake power house. The alternating current is delivered to 500 k. w. static transformers situated in the power house and wound for 400 volts primary. It is then stepped-up to a pressure of 16,500 volts and conveyed by the three-wire system a distance of 16 miles, to a sub-station at York Mills, where it is passed through step-down transformers and rotary converters and reduced to 550 volts direct current, at which it is delivered to the entire line.



Metropolitan Railway—Engine Room.



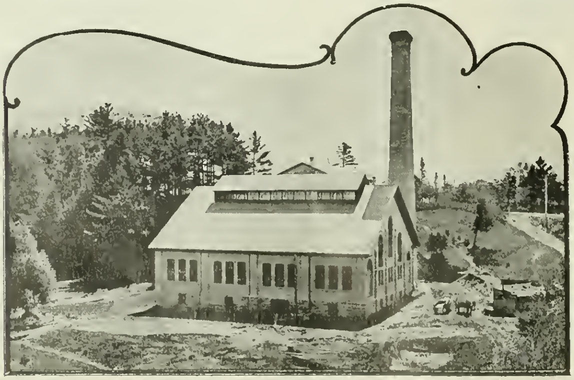
Metropolitan Railway—Generators and Switchboard.

The rotary converters in the sub-station are operated at 710 r. p.m. and each is excited on one side by an induction motor of 25 horse power, a synchronizing motor for operating the plant being on the south side. The generators, rotary converters, transformers, and switch-board equipment were furnished by the Westinghouse Company.

The poles for the transmission line are of cedar and set 100 feet apart. No. 4 covered copper wire is used. The trolley wire is No. 2-0 and the feed wire No. 4-0 bare copper, with a feeder into the trolley wire every tenth pole.

The company is well provided with rolling stock, the Canadian General Electric Company and the Westinghouse Company having furnished the motor equipment. For hauling freight a Baldwin-Westinghouse electric locomotive of 200 h. p. is used.

Mr. J. W. Moyes is general manager and superintendent of the road.



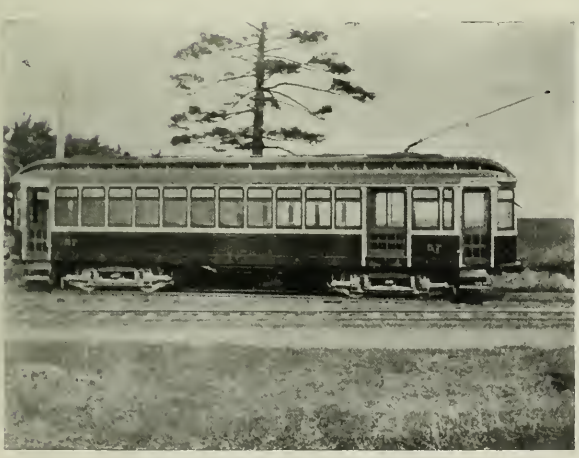
Metropolitan Railway—Power House at Bond Lake.

The corporation of Coaticook, Que., has purchased the electric light plant for $36,000, and wiassume control in October.

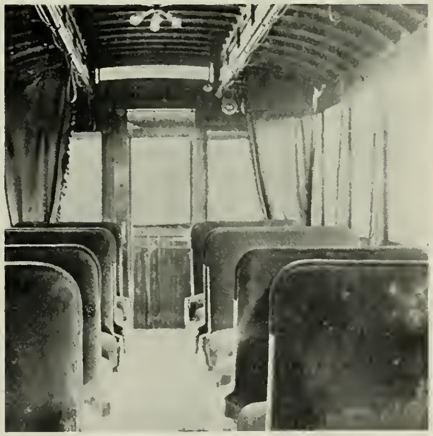
Cars in Snowdrift.

Snowdrift in the Ridges.

View at Thornhill.



One of the Cars, 47 Feet Long.



Interior of One of the Cars.

VIEWS OF THE METROPOLITAN RAILWAY—TORONTO TO NEWMARKET.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY
THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.

1ST VICE-PRESIDENT:
EDWARD SLADE, General Superintendent Jacques Cartier Light & Power Co., Quebec.

2ND VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
ORMOND HIGMAN, Chief of Electrical Inspection Department, Ottawa.
ED. A. EVANS, Manager Quebec Railway, Light & Power Co., Quebec, Que
A. A DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
A. SANGSTER, Manager Electric Light & Power Co., Sherbrooke, Que.
A. A. WRIGHT, M. P, President Electric Light & Power Co., Renfrew Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON,	Toronto
Vice-President, CHAS. MOSELEY,	Toronto.
Treasurer, A. M. WICKENS,	Toronto.
Registrar, J. G. BAIN,	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN,	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER	Baden, Ont.
Vice-President, H. E. TERRY,	Toronto, Ont.
Secretary, W INGLIS,	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont.
Conductor, J. STRUTHERS,	Sarnia, Ont.
Door Keeper N. BEAN,	Waterloo, Ont

Fan Motors. The fan motor is a small piece of machinery when it is manufactured and in stock ready for the market, but an immense amount of ingenuity is spent every year in getting out types which can fairly claim to be improvements over those of the previous season. The adjustable swivelling and trunnion frames, capable of directing the breeze to any desired point, were the first improvements. The present practice is tending almost the other way, in that efforts are being made to give a distributed flow of air. This is accomplished in one type by spreading the breeze, which travels in a horizontal instead of a vertical plane, over a cone with a vertical axis. In another design a set of oscillating blades divert the air from side to side; the same result is accomplished by another maker by swinging the fan itself over part of a circle. Still another method is to let the complete fan swing all the way round, which is accomplished by mounting it on a swivel with the necessary current collector rings. Every year sees this little instrument regarded more and more as a necessity rather than a luxury. Would not a vigorous canvass among your customers result in the addition of many of them to your load?

Transpositions. All wires carrying alternating currents exert effects upon neighboring conductors which tend to disturb the normal voltage carried by the latter, the amount of this distortion, under ordinary practice as to distances apart, amperage, voltage, etc., often being such as to seriously mar the proper operation of the system unless some means of neutralizing these effects be introduced. This disturbing action may take place between the various wires of the same circuit, or between different circuits, and is caused by two distinct phenomena, namely, electrostatic and electromagnetic induction. There is as yet no commercial remedy for the former, but the latter under its more familiar title of mutual induction can be neutralized by the introduction into the line of transpositions, which consist of a change in the relative locations of the various wires on a pole. The question as to the proper number of transpositions necessary, and the best location for them, is a matter for considerable investigation before the line is erected. Transmissions of moderate length and capacity, either three phase three wire or two phase four wire, if symmetrically erected in the shape of an equilateral triangle for the former, and the diagonals of a square for the latter, require no transposition to avoid mutual effects in the lines themselves. Regarding interference to or from neighboring lines, a three phase system would have to be barrelled twice in order to divide it into three equal parts, which would neutralize each other. Similarly a two phase system has to be rotated at three points, the four resulting sections neutralizing each other. The amount of disturbance permissable depends, of course, on the regulation desired; obviously more distortion is allowable on lines supplying principally motors than on those carrying a lighting load; thus, on power lines of moderate size, where different circuits do not parallel each other for more than say, two or three miles, transpositions can often be omitted with advantage. Induction in telephone and telegraph lines is usually taken care of by transpositions in the lines supplying these instruments.

The former device is the much more sensitive to outside influences, and requires as a rule frequent transpositions, though when telegraph instruments are operated on a grounded circuit, there is usually a great deal of interference, which is more likely due to leakage than induction, and which, therefore, cannot be entirely cured by transposing. On the whole, it would seem to be advisable to reduce the number of transpositions to the lowest possible practical limit, wherever possible omitting them entirely. They are a weak point in line construction, always liable to trouble, and if it is subsequently found, due to changes in the load or distribution, that more are desirable, they can then be put in without difficulty.

Transformer Types

The question of a choice between air blast and oil cooled transformers has always been a difficult one, the advocates of both types having many arguments in favor of one style or the other. The use of an artificial draught of cooling air, which can positively be forced through every part of the apparatus, say the air blast men, ensures that the interior of the transformer shall be but little hotter than the outside. To this is made the reply that moving machinery, which requires constant attention, and which may fail at some critical moment, is necessary for the production of this air blast, whereas the oil cooled type is absolutely self contained and possessing no moving parts or accessories, requires but the minimum of attention. On the other hand, the presence of this cooling oil involves the addition of a serious fire risk, which is but imperfectly compensated for by the oil tight brick guard walls which are frequently built round the apparatus. Besides this the type is heavier and therefore costs more than the air blast, both originally and also for freight and handling. To compensate for this, the oil cooled apparatus can be installed in situations where, owing to an exceptionally dusty or damp atmosphere, the use of air blast equipments might be inadvisable. Further, it is claimed that the former is less liable to damage from lightning, as the oil would flow into any puncture which might take place and heal it immediately. Again, there being no opportunity for foreign matter to get into the case, there can be no stoppage of the oil channels, whereas in the air blast type dust and dirt, if not periodically blown out, soon accumulate to an extent sufficient to materially reduce the cooling effect of the air. It will thus be seen that there are a great many points to be looked after when deciding on an equipment, and that a decision can be reached only after due consideration has been given to the advantages and demerits of each type.

Compounding Alternators.

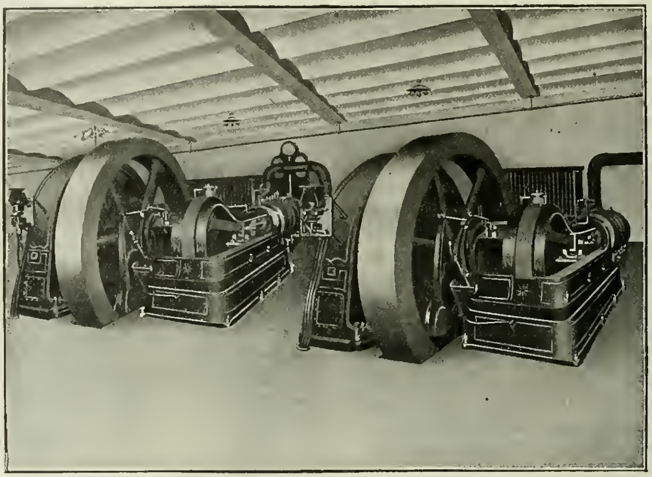
The compounding of alternators to automatically maintain a desired potential at any designated point, irrespective of changes in load and speed, is a most difficult problem which has for years engaged the attention of designing engineers. In direct current work the only factors to be taken care of are the amperage which is being delivered and the speed of the machine, but in alternating circuits a third quantity is encountered, namely, the power factor of the load, which tends to render the regulation of this class of apparatus much more complicated than the former. The first attempts to compound alternators were the commutating machines of the Westinghouse and General Electric Companies, which depended for their regulation on nothing but variations in the amperage, being independent of the speed and the power factor. Later there came the compensated type of the General Electric Company, which was a step in advance in that both power factor and amperage were taken care of, but there existed no means of correction for changes in speed. This company has now brought out a new instrument, the Tirrill regulator, which takes account of variations in all three factors and which would thus seem to be a marked step towards the solution of the problem. The principle used in accomplishing this result is that of using the voltage to be controlled as the main actuating force of the apparatus, which would seem to be the logical method of attacking the question. In outline the apparatus consists of a vibrating contact which when closed short circuits the exciter field rheostat; conversely when this contact is open the rheostat is put back into the circuit. The rate of opening and closing this contact, and therefore the average effect of the exciter field rheostat, is controlled by a coil energized from the voltage which is to be regulated. If the voltage falls, from any reason whatever, the vibrating contact, through a suitable arrangement of mechanism, shortcircuits the field rheostat for a greater length of time, and thus raises the voltage of that machine, which in turn tends to restore the alternating potential to its normal point. In addition to the potential winding on the actuating coil controlling the moving contacts there is provided a current coil which, in series with the load, can be used to give increasing potential as the amperage rises, the degree of compounding being varied by inserting more or less turns of this winding as desired. It will also be seen that the potential winding of this coil can be energized either from the bus-bars of the station or from any desired distributing point by means of pressure wires run back to the power house. The apparatus is self-contained and built for switchboard mounting, and as it entails no change in the machines to be governed, can be applied to existing installations with no outlay other than that for the regulator itself and the necessary winding. This, combined with its simplicity, would make it appear that the device is going to find a large field of usefulness, as the growing use of polyphase plants furnishing both light and power from the same bus bars is continually calling for better voltage regulation, and this in the face of large and sudden variations in both load and speed.

Mr. J. T. Fanning, hydraulic engineer, of Minneapolis, recently made an inspection of the water power of the Kakabeka Falls near Fort William, Ont. He will make a report to the capitalists who are financing the development for the Anglo-American Power Company.

"Burn your name into the public mind" is the axiom of the Edison Electric Illuminating Company of Brooklyn, and by way of aiding merchants to follow it the company furnishes handsome illuminated electric business signs free of cost to those who will pay for current. A fine booklet shows various styles of signs, with estimates of cost per month, and also demonstrates the beauty and advertising value of electric signs by means of views taken in Brooklyn streets. "Solid Comfort or the Matchless Man" is an illustrated booklet enforcing the conveniences of an electrically illuminated home, while several small folders treat of other electrical conveniences.

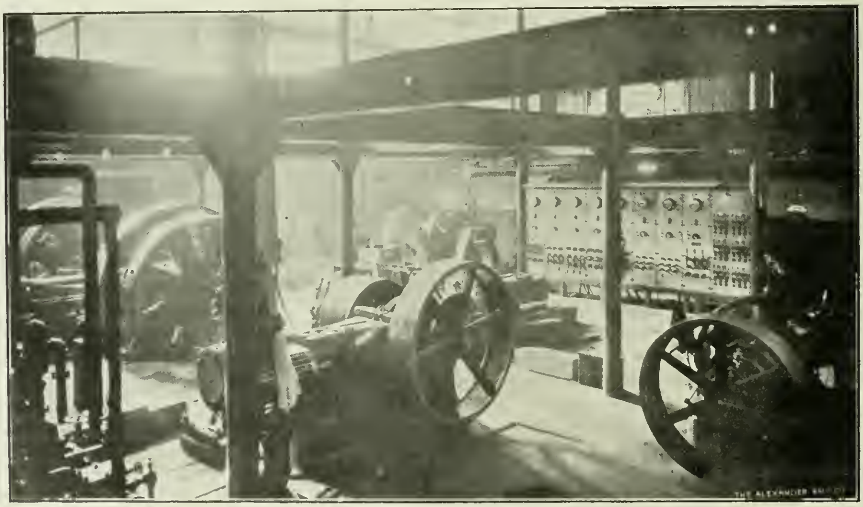
ELECTRICAL EQUIPMENT OF THE EATON DEPARTMENTAL STORE.

What is beyond doubt the largest private electric plant in Canada is that to be found in the departmental store of the T. Eaton Company, Toronto. Owing to the rapid growth of the store, it became necessary to extend the plant from time to time, until to-day its capacity is upwards of 2,000 horse power. The floor space of the store is equivalent to about 15 acres and employment is given to 4,800 hands. The power plant, as well as all the engineering details of the building, is in charge of Mr. George Thomson, the chief engineer, who has been associated with the company for thirteen years.


The T. Eaton Company—Pair of Robb-Armstrong Engines.

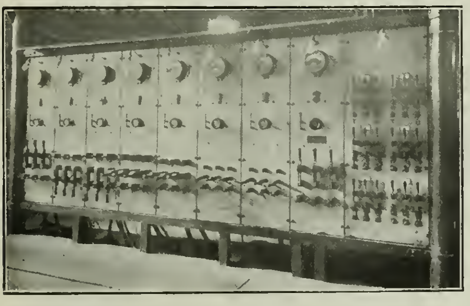
The boiler room is 40 x 68 feet in size, with a coal bunker adjoining of a capacity of 300 tons. The boilers are all of the Heine type and include five of 150 h p., two of 410 h.p., and one of 410 h.p. about to be installed. The boilers have automatic feeds and are equipped with Jones stokers. The forced draft apparatus consists of a pair of Robb-Armstrong engines and McEachren fans. The amount of air is controlled by steam pressure by means of a Foster regulator. There are three feed pumps, of Northey make.

The generating room is 80x60 feet in size, with concrete floor and a height of 27 feet to the ceiling. Two 225 k. w. C. G. E. generators are coupled direct to two 350 h. p. Robb-Armstrong tandem compound engines 15x26x24 ; four 130 k. w. C. G. E. generators are coupled to four 175 h. p. "Ideal" engines, manufactured by the Goldie & McCulloch Company ; one 50 k. w. C. G. E. generator is coupled to a 75 h. p. 12x12 Robb-Armstrong engine, and one 25 k. w. C. G. E. generator is coupled to a 10x10 Robb-Armstrong engine of 40 h. p. In addition there is now in course of installation a 225 k. w. Westinghouse generator to be direct-connected to a Robb-Armstrong engine, 21x24, of 400 h. p. This engine will be fitted with the new Corliss valve gear, consisting of an eccentric, a steel rocker and straight connection to valve. By means of a special form of rocker arm the valve is moved more quickly at one end of its stroke than the other, the effect of which, it is said, is to give even and regular indicator cards.


The T. Eaton Company—Generators and Engines.

The generator switchboard, show in the illustration, is of marble, 7x18 feet. There are eight generator panels and one distributing panel. Each generator panel contains three single-pole double-throw knife switches, rheostat, Weston ammeter and voltmeter switch. The distributing panel controls the power and incandescent and arc light circuits for the factory building and the stable. The current for the main store is conveyed by means of cables to a distributing switchboard located in a sub-basement beneath the store. The wiring is of the three-wire 220 volt system.

For lighting the main floors of the store arc lamps are used, of which there are upwards of five hundred. The basement of the store, the factory building and the stable are lighted by incandescent lamps, the number now in use being 4,000.



The T. Eaton Company—Switchboard.

In the factory building 1,400 persons are employed. All the machinery is motor driven, there being forty-two motors of a combined capacity of 200 horse power. These are employed largely for operating 1,200 sewing machines for making underwear, skirts, cloaks, costumes, gents' clothing, furs, neckwear, etc., the goods being sold entirely over the counters of the store.

Motors are also employed for driving the blowers for operating the cash system, there being four of 50 h. p. each used for this purpose. Four 6 h. p. motors operate small ventilating fans, while the vestibules are heated by air blown through steam coils by means of motors.

The load on the plant is at times quite heavy, as is shown by the figures for the month of December. The maximum load in that month was 6,050 amperes, the minimum load 2,500 amperes, and the average load 4,190 amperes for a ten-hour run.

The cold storage plant, installed by the Linde British Refrigerating Company, and adjoining the engine room, consists of two 10-ton compressors, coupled to a 12x28 Wheelock engine. The combined ammonia and brine system is used and is believed to give the most satisfactory results. The cold storage room is 100x30 feet, divided into six compartments, and is used for storing meats, poultry, and fresh and preserved fruit, principally for lunch room purposes. Three refrigerators in the meat and grocery section of the store, as well as the soda water fountain and cut flowers, are kept at a proper temperature by means of the refrigerating plant.

The elevators are twenty-two in number, of Fenson make, and hydraulically operated. Fifteen of them are located in the store, five in the factory and two in the stable. The pumping plant for the elevators comprises two compound duplex Northey pumps, 16 x 24 x 16 x 24, and one compound duplex Northey pump 14 x 20 x 14 x 18.

The building is heated by the two-pipe system by means of exhaust steam exclusively.

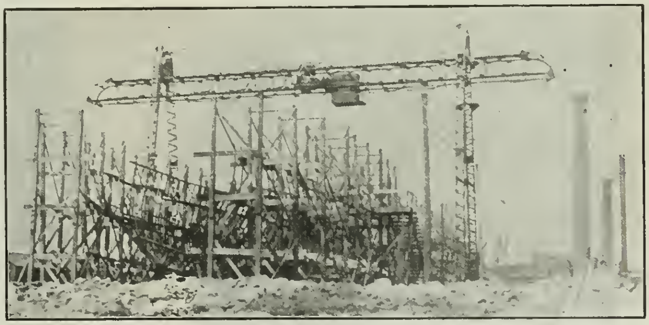
The cash system of this store is claimed to be unsurpassed in America. It is the pneumatic tube process, handled by four No. 7 positive pressure blowers. Each blower takes 56 cubic feet of air per revolution and operates at 120 revolutions per minute, making a total of 26,880 feet of air handled per minute. This air is discharged outside, and, being replaced by fresh air, provides considerable ventilation for the building. There are 203 cash stations located in all sections of the store. The average length of each line is 150 feet, showing that a total of 30,450 feet of brass tubing is required for the cash system.

An interesting conveyor system is employed for carrying parcels from one section of the store to another. The largest of these conveyors is 640 feet long and is used at the present time for mail orders, the rubber belt employed being 30 inches wide. There are three other conveyors for city parcels.

Much attention has been given by the management of the store to a fire protection system. There is a fire alarm system with four stations on each floor. Each building contains an automatic sprinkler equipment, while on each floor there are located fire extinguishers and about 400 feet of hose. There is a well equipped fire brigade of twenty persons constantly ready for duty.

ELECTRIC TRAVELLING CRANE.

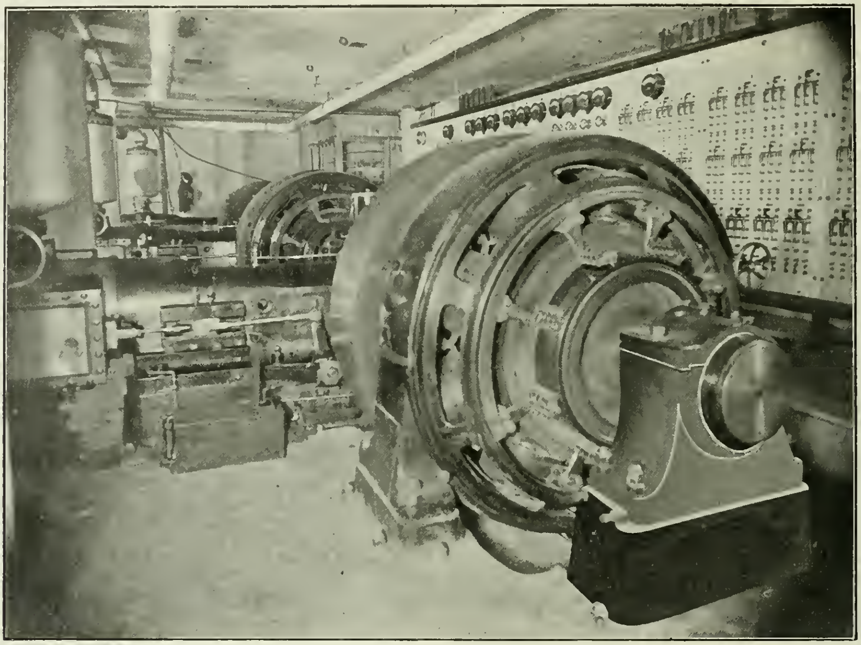
The electric travelling gantry crane illustrated herewith is in use by the Polson Iron Works Company, Limited, Toronto, at their ship yards. The rails are 70 feet apart and extend for about 500 feet, so that the steel work for two or three boats under construction at the same time may be readily delivered at the proper place. The boom is 120 feet long and is about 60 feet from the ground. The electric equipment was manufactured and installed by The United Electric Company, Limited, of Toronto, and consists of two 25 h. p. and one 5 h. p. multipolar, "Superior" type motors in weatherproof casings, together with the usual reversible controllers, trolley fittings, etc. The illustration shows two light ships under construction for the Dominion Government for use in maritime waters. The contract for the generators, engines, and flashing devices (two complete outfits for each vessel) has also been awarded to The United Electric Company, and the same company has just installed a motor for the reversible hoist for operating the sheer legs which are used at the Polson Iron Works for placing machinery in vessels and even lifting bodily from the water vessels of considerable size. The Polson Iron Works have greatly increased their facilities and are becoming one of the largest iron works in Ontario. They have lately installed some very heavy machine tools direct driven by U. E. Co. motors; some of these tools being imported from Scotland, and others made by John Bertram & Sons, Dundas, Ont.



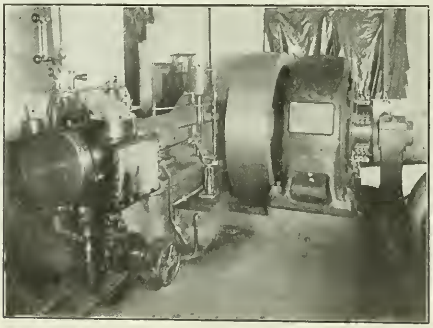
Electric Travelling Crane at the Polson Ship Yards, Toronto.

THE KING EDWARD HOTEL PLANT.

The new King Edward Hotel is a handsome building, elaborate in its appointments, and containing many features which will interest visitors. Persons attending the C. E. A. convention will probably be most attracted by the electric plant, which is in charge of Mr. Alex. Storer. The boiler equipment consists of four return tubulars of 150 h.p. each, manufactured by the Polson Company. There are two C. G. E. 150 k. w. 220-volt direct current machines operating at 215 r.p.m., one of 100 k.w. operating at 270 r. p. m., and one of 50 k.w. operating at 300 r.p.m., all coupled to Robb-Armstrong side-crank, non-condensing engines, the exhaust steam being used for heating. These are operated on the two outside wires of the three-wire system, the neutral being obtained by motor generator balancing sets, of which there are two of 25 k.w. capacity each.



King Edward Hotel, Toronto—Three of the Units.



King Edward Hotel, Toronto—The 50 K. W. Unit.

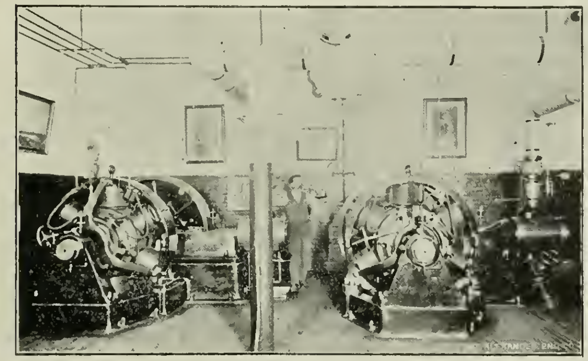
Two Wheelock engines operate the cold storage system and an artificial ice-making plant.

The switchboard in connection with the generating plant is 25 feet long and nine feet in depth. It is of marble, with marble pillars at each end and brass grille work surmounting it. It is set upon a marble and tile floor and has a brass guard rail. The instruments are of the standard equipment. Provision has been made for the machines to be thrown on to the power bus-bars or lighting bus-bars, or both, as desired, and connection has been made so that the city mains may be used if required.

Mr. Alex. Storer,
Chief Engineer King Edward Hotel.

The building is heated by exhaust steam, the valves on the radiators being actuated by compressed air furnished by a small pump situated in the basement. A dial is placed on the wall of each room and the setting of the indicating finger to the temperature desired opens or closes the radiators, through the compressed air system, as the temperature falls below or rises above the desired point, as indicated by the dial. There is also a blowing engine for supplying compressed air for operating carpet sweepers. Throughout the building there are various stationary motors for operating fans, laundry machinery, etc.

The wiring has been executed in conduit, the different floors being provided with panel switchboards and all corridor lights being under lock switches—the latter a rather unique feature. Each room is provided with a telephone, with long distance connection to all parts of the country, there being the necessary switchboard and independent motor generator sets for this purpose.



Electric Plant at the Union Station, Toronto.

The elevators, three passenger and two freight, were installed by the Marine Engineering Company, of New York. They are operated electrically and have the usual solenoid control.

The entire power equipment, including engines, generators, switchboard and wiring, was contracted for by the Canadian General Electric Company, the Robb Engineering Company, of Amherst, N. S., and the Bennett & Wright Company, of Toronto, being subcontractors for the engines and wiring respectively.

Mr. Alex. Storer, the chief engineer, came from Scotland to this country when a small boy. He served his apprenticeship as machinist in the shops of the Toronto and Nipissing Railway at Uxbridge, Ont., and later gained considerable experience on the road. Subsequently he installed the plant at the Union Station, remaining in charge for seven years and resigning to accept his present position.

Mr. Geo. Storer,
Chief Engineer Union Station.

ELECTRIC PLANT AT THE UNION STATION.

A very neat electric and steam plant is to be found at the Union Station, Toronto. The engine and dynamo rooms are extremely well lighted from windows opening on a lane on the west side of the building. The floors are of concrete, and everything about the place is clean and cheerful. There are three Babcock & Wilcox boilers, one of 186 horse power and two of 93 horse power. Another of 186 h.p. is now being installed. These boilers are fitted with Murphy automatic stokers, and were the first furnaces installed in Canada in connection with which these stokers were employed. The fuel is fed into a hopper from which it descends into a magazine, and from thence is automatically fed into the fire. Cold air is admitted just above the coal, by which means the smoke is consumed. The power required for the automatic feeding device is supplied by a 1 horse power automatic engine attached to the end of the furnace.

Screenings are exclusively employed for fuel. This fuel is brought into a lane on the west side of the building and dumped through a coal hole into the proper place in the boiler room. It is then placed into a bucket of 1300 pounds capacity, which is carried by means of a compressed air hoist to a track above the boilers. The bucket is then moved along the track to the desired point and dumped. By means of this compressed air hoist the ashes which come from the furnace are also lifted in buckets through another coal hole into the lane, where they are dumped into carts. This compressed air hoisting apparatus is in use at many points on the line of the Grand Trunk Railway, and was manufactured at the company's works at Point St. Charles. The compressed air is pumped into a reservoir suspended from the ceiling.

Mr. W. Fuller,
Electrician Union Station.

Turning now to the steam and water apparatus, all returns come back from the south side station and the new station to a return tank, from which they are pumped again to the boiler. The pumps for this purpose were also made at the Grand Trunk Company's works at Point St. Charles. The quantity of water is regulated by an automatic governor which shuts off the steam at given points. On account of the distance to which the steam has to be forced to the south side station, the return water is cold when it gets to the pump, in consequence of which it is forced through exhaust heaters before going into the boilers. The elevators in the building are hydraulic, and after the water has done its work at the elevators it is pumped back again into the pressure tank by a Northey pump, 14 x 8½ x 12 inches, fitted with a Fisher governor. In order to get the right quantity of air into the pressure tank, the air is taken from the air reservoir above referred to. In case of accident to the pump, the city pressure can be employed to run both passenger and baggage elevators.

There are two Robb-Armstrong high speed engines of 80 horse power each, fitted with automatic oilers. The exhaust steam from these engines is used to heat the buildings. The steam pipe to each engine is 4 inches in diameter, and the exhaust pipe 5 inches. Should the engine get a dose of water, automatic valves are immediately released, by means of which the water is got rid of. The engineer in charge is Mr. George Storer, who is well qualified for the position he occupies. Mr. W. Fuller is electrician for the Union Station Company.

Coming now to the electric plant, about 2,000 lights have been installed, forty of which are arc lights. For the operation of these lights two Canadian General Electric Company generators are employed. Both arc and incandescent lights are run off the same generator. By means of a triple pole switch the current can be obtained from the Incandescent Light Company, in case of accident to the generators or when repairs have to be made. The building is wired for both the two and three wire systems.

The switchboard consists of green slate panels, on which are mounted two Weston volt meters, two ammeters, sixteen 3 pole switches, two 2 wire dynamo switches, one break-down switch and two pilot lamps.

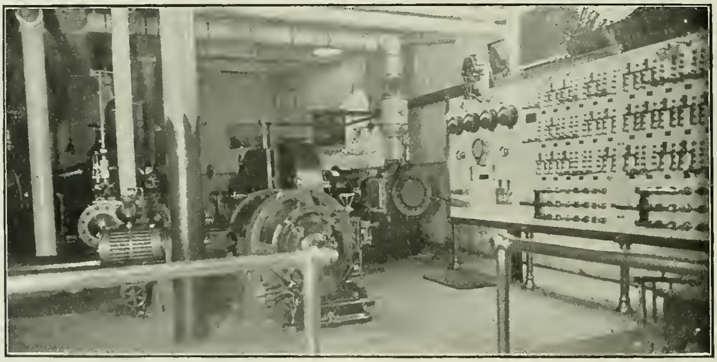
The generating plant, in addition to lighting the buildings, furnishes current for the electric signal system installed by the company a few years ago. The switches and semaphores are lighted by incandescent lamps placed inside of discs carrying colored glasses, which revolve around the stationary lamp and display the different signals.

ELECTRIC PLANT AT THE CITY HALL.

An interesting isolated plant, recently installed, is that at the City Hall, Toronto. There are two boiler rooms, the one located to the east of the engine room containing four Heine water tube boilers, one of a capacity of 250 h. p. and three of 150 h. p. Three are equipped with the Holly down draft furnace and one with the straight bar. The boiler room on the west contains four tubular boilers, 60x14, manufactured by the Polson Company, of Toronto. Three of these are equipped with the Jones underfeed stoker and one with the straight bar. The Heine boilers are controlled by the Johnson damper control and the tubular boilers by the McDonough damper regulator, which controls the speed of the engine on the fan system.

Coal is delivered by means of trucks direct from the coal bin, which has a capacity of 150 tons, each fireman keeping an accurate account of the amount of coal burned during his run. The ashes are removed by means of cars and an elevator provided for the purpose.

The feed pumps are three in number, of Northey make, and are controlled by a pump governor. Each pump is sufficiently large to handle by itself the entire plant.



City Hall, Toronto—General View of Electric Plant.

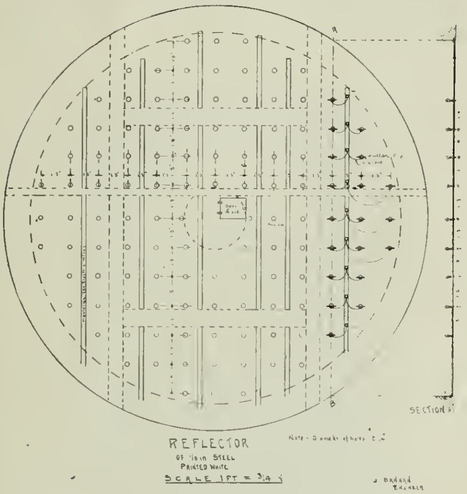
The generating room has a concrete foundation. The unit shown in the foreground in the illustration comprises a 9x10 McEwen engine, of Waterous manufacture, direct connected to a United Electric Company 25 k. w. dynamo. The other unit consists of a 16x17 Robb-Armstrong engine direct connected to a Canadian General Electric 100 k. w. machine. During the day time the load, which is not over 100 amperes, is carried by the small unit, while the larger machine is operated to take the heavier load at night and the small unit is shut down. In this way the plant is operated very economically.

The switchboard, 6x20 feet, of marble, also installed by the Canadian General Electric Company, contains the usual equipment of ammeters, switches, etc. The board was mounted by the Crouse-Hinds Company, of Syracuse. Each machine is supplied with an improved circuit-breaker. All circuits are handled by individual switches on the board, in charge of the engineer. A 1,200 ampere Thomson recording watt-meter gives the proper reading and watts output.

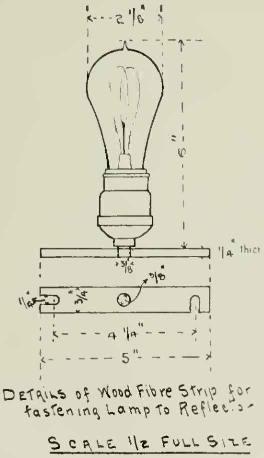
Two motors of 1½ h.p. each are located in the attic, and are intended for taking ventilation from the lavatories.

The wiring throughout the building is of the two-wire system, equipped with junction boxes at intermediate points to properly handle the current. There are connected up 3,300 16 c. p. incandescent lamps, in addition to the tower clock lighting, the wiring having been executed by the Bennett & Wright Company.

Mr. James Bannon, the chief engineer, is now installing the tower clock lighting. As the result of considerable experiment, he has devised a system which he believes will give splendid satisfaction. The plan proposed is shown by the accompanying illustrations. He proposes to use 480 8 c. p. incandescent lamps, 120 on each dial, placed 17 inches apart, and fitted up with 22 gauge galvanized iron reflectors properly stayed and braced to the present wind braces. The lamps will be 20 inches distant from the dial and each individual lamp will be handled separately and seen from the inside, so that they can be replaced in a moment's notice in case of accident to any of the circuits. The holes in the reflectors through which the lamps are inserted are 2¼ inches in diameter and will permit sufficient daylight to light the present room, also the necessary circulation of air inside the reflector when the lamps are lighted. The lamps are perfectly insulated by means of a wood fibre strip, as shown in the drawing. The mains of the clock lighting are open wiring to the base of the tower, then conduit until the tower shaft is entered, then open wiring again to the dials. In the installation enough copper has been provided to meet the requirements for outside illumination at any time, it being possible to tap the line at any point for this purpose.



Proposed Plan of Lighting Tower Clock of City Hall, Toronto.



The dials of the clock are 20 feet 6 inches in diameter and a height of 265 feet from the sidewalk. The usual custom is to light clocks of this size by means of arc lamps or 16 c. p. incandescent lamps. Mr. Bannon found, however, that in most cases the individual lamps could be discerned from the outside, to obviate which he decided to make use of lamps of eight candle power, by means of which, he claims, a more even distribution of light and more satisfactory results will be obtained. By a proposed treatment of the glass in the dials, it is expected that the lamps will not be discernible from the outside, as is usually the case. It is estimated that 100 amperes will be required to light the clock, which was installed by Gillett & Johnston, of Croydon, Eng., and is now running very accurately, the variation not exceeding two seconds per month.

Mr. James Bannon,
Chief Engineer City Hall, Toronto.

The chief engineer has also under his charge fifty pneumatic clocks throughout the building, controlled direct from the engine room and furnished by the Johnson Electric Service Company, of Milwaukee.

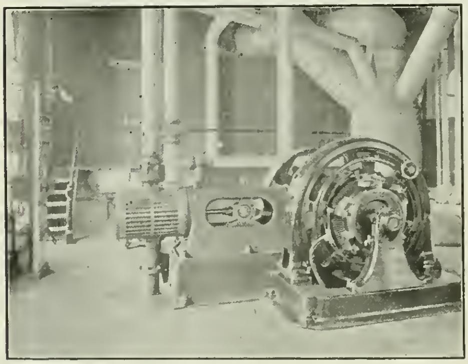
The steam heating of the building is accomplished by means of the one-pipe system, all exhaust steam being utilized for that purpose during the winter months. The temperature of all rooms is controlled automatically by thermostats installed by the Johnson Heat Control Company. A complete circulation throughout the building, with one atmosphere, is obtained with the Paul system attached to the heating system, and the whole being controlled by the switchboard in the engine room. A system of ventilation is furnished by four Sturtevant engines, 8x10, located in the basement and direct-connected to Sturtevant fans, which take air from the extreme top of the tower and force it to all rooms in the building. The ventilation is also controlled by the Johnson heat control device, the temperature during the winter months being set at about 68 degrees Fah. The air is heated by steam coils using live steam at ½ pound pressure. The capacity of the fans is equivilant to changing the air in the entire building once in eight minutes. The exhaust from each room enters large stacks, one located on each side of the building, and is carried outside.

The elevators, three in number, were installed by Leitch & Turnbull, of Hamilton. There is one on each side of the building and one in the tower. The elevator pumps were made by the East Buffalo Pump Company and are of the size 12x18x10x12. Any one of them will handle the elevators during the day ; at night the pumps are shut down and the elevators worked entirely on city water pressure of 80 pounds. During the day the compression tanks carry 120 pounds pressure. During the tourist season the tower car is worked continuously, it being open to the public from May 1 to November 15.

Mr. James Bannon, chief engineer, has been associated with the plant since 1900, having had entire charge since March, 1892. This position he secured through a competitive examination, and the efficient manner in which the plant has since been operated shows that he is well qualified to discharge his duties. He was formerly employed as engineer at the Island Waterworks, and later at the Parliament Buildings under Mr. A. M. Wickens.

ELECTRIC PLANTS IN TORONTO.

An illustration is shown herewith of the electric plant at the City Dairy, Spadina Crescent, an institution well worthy of a visit. A C. G. E. 125 volt direct current generator is connected to a McEwen engine, the current being used for both lighting and power. The switchboard is of standard equipment. There is also a Wheelock engine for driving the refrigerating plant.



Electric Plant at City Dairy, Toronto.

About two years ago the Lever Bros. Company installed at their soap works in the east end of the city a plant for power and lighting. There are two Heine boilers and a Robb-Armstrong engine. The generator is a 200 volt 125 k.w. machine operating at 240 r.p.m. and manufactured by the United Electric Company, of Toronto. The generator supplies current for a dozen motors throughout the works, as well as for arc and incandescent lamps. The switchboard is of pink Tennessee marble and is fitted with Weston instruments and the usual automatic circuit breakers, switches, etc. The generator, motors, switchboard and arc lamps were all manufactured by the United Electric Company.

Electricity is employed for both power and lighting at the works of the Gutta Percha & Rubber Company in Parkdale. Two 50 k.w. 125 volt C.G.E. generators are direct connected to "Ideal" engines manufactured by the Goldie & McCulloch Company, of Galt.

An isolated plant of considerable size is that in the Temple Building, corner of Bay and Richmond streets. The steam plant consists of two Heine boilers of 180 h.p. each fitted with Jones underfeed stokers. Three direct current 50 k.w. Walker generators, installed by the United Electric Company, are direct connected to "Ideal" engines. One generator is wound for 250 volts and is running at 275 r.p.m., supplying current for motors and electric elevators. The other two generators are wound for 125 volts and furnish the current for lighting. A motor generator of 80 lights capacity supplies lighting during the day-time. The switchboard and wiring were contracted for by the Bennett & Wright Company.

One of the first electric plants to be installed in the city is that of the Incandescent Light Company on Teraulay street. There are six return flue boilers of 175 h.p. each and two Babcock & Wilcox water tube boilers of 400 h.p. each. The engines are six in number, two straight lines, three Armington & Sims, and one Lake Erie cross compound. The generators are of the Edison type, manufactured by the Canadian General Electric Company at Peterboro.

Electric plants are also in operation at the Parliament Buildings, Mercer Reformatory, the Asylum, and several other buildings, but lack of space prevents further reference.

MOONLIGHT SCHEDULE FOR JULY.

Date.	Light.	Date.	Extinguish.	No. of Hours.
July 1	10 30	July 2	3 30	5 00
2	11 00	3	3 30	4 30
3	11 30	4	3 30	4 00
5	0 15	5	3 30	3 15
6	1 00	6	3 30	2 30
7	1 40	7	3 40	2 00
8	No Light	8	No Light	.....
9	"	9	"	......
10	"	10	"	.....
11	8 10	11	10 10	2 00
12	8 10	12	10 30	2 20
13	8 10	13	11 00	2 50
14	8 10	14	11 30	3 20
15	8 10	16	0 00	3 50
16	8 00	17	0 30	4 30
17	8 00	18	1 10	5 10
18	8 00	19	1 45	5 45
19	8 00	20	2 30	6 30
20	8 00	21	3 15	7 15
21	8 00	22	4 00	8 00
22	8 00	23	4 00	8 00
23	8 00	24	4 00	8 00
24	8 00	25	4 00	8 00
25	8 00	26	4 00	8 00
26	8 00	27	4 00	8 00
27	7 50	28	4 00	8 10
28	7 50	29	4 00	8 10
29	7 50	30	4 00	8 10
30	7 50	31	4 00	8 10
31	10 00	Aug. 1	4 00	6 00
		Total	....	151 25

The Galt, Preston & Hespeler Electric Railway Company have recently added to their rolling stock a new passenger car, 51 feet long and equipped with all modern accessories. Electric buttons are placed on the sides at each seat so that passengers can ring when wishing to alight. It is lighted with 32 incandescent lamps.

THE G. N. W. TELEGRAPH COMPANY.

As no doubt most of our readers are aware, the general offices of the Great North-Western Telegraph Company are located at Toronto. The building which the company occupies on the corner of Wellington and Scott streets was built by the Montreal Telegraph Company, for its own use, under the supervision of President and General Manager Dwight, about thirty years ago, and was taken over by the Great North-Western Telegraph Company at the time the Montreal and Dominion Telegraph Companies were merged in the Great North-Western in 1881. When the building was first erected it was justly considered a very handsome edifice, and it certainly was one of the most commodious and best-planned telegraphic offices of its day. The whirligig of time works wondrous changes, however, and where, under the old order of things, there was plenty of room and to spare, the company now finds itself, with its largely increased business, somewhat cramped for space, and several rooms in the adjoining building have been secured to accommodate a portion of the staff.

MR. H. P. DWIGHT,
General Manager G. N. W. Telegraph Company.

The telegraph business, in keeping with the general business of the country, has increased by leaps and bounds during the past few years, and the Great North-Western, besides strengthening and improving its plant in all directions, has from time to time, to meet the increased traffic, added a number of new wires to the most important routes. This work, of course, has been in charge of the enterprising and able superintendent of construction, Mr. A. B. Smith, who, always a busy man, is in his element when immersed in work in which a bold push is required to complete a certain job in a specified time. Quite recently a copper wire of the most approved gauge was erected between Buffalo and Montreal. This wire is worked quadruplex. It need scarcely be explained that this allows of transmitting messages two ways in opposite directions over a single wire, thereby enhancing the usefulness of the wire fourfold. Six quadruplexes are in constant use in the Toronto office of the Great North-Western.

A very interesting feature of this company's operations here is the Ticker Service. The aerial galvanized wires over which the New York and Local Stock Ticker circuits and the Sporting Ticker circuit were formerly worked have been removed, and copper wires substituted, greatly improving the efficiency of these circuits. The demand upon the resources of the G. N. W. by brokers and financial agents for leased wires has received a decided impetus lately. The Great North-Western has an exclusive connection with the Western Union Telegraph Company, and President Dwight returned only the other day from New York, where he had been in consultation with Col. Clowry, President and General Manager of the Western Union, in regard to matters of interest to their respective companies. While Mr. Dwight was in New York arrangements were made for the erection of additional wires during the coming season to meet the increased demands of international business.

The Great North-Western has just finished re-wiring its Toronto operating room—putting in a new Bunnell switch, capable of accommodating 100 lines, and introducing other new telegraphic apparatus. The switch is a very elaborate affair, and quite an ornament to the office. The latest pattern of loop switch has also been added to the office equipment. These two switches allow of any possible combination of wires likely to be called for in a telegraph office. All the old wiring under the operating room floor has been removed, and cables have been laid in metallic troughs carrying a new set of wires, with carefully soldered joints, to every instrument in the office. The operating tables, which are also new, are what is known as the sextette pattern, seating six operators, three on each side of the table. The work of making these changes has been in progress, by easy stages, for the past six months, the change, which was under the immediate direction of Inspector W. J. Duckworth, having been effected without causing a moment's interruption to any of the wires in the building. It may be confidently asserted that the operating room of the G. N. W. at Toronto is now in every respect one of the best organized and equipped, and as thoroughly modern in all its appointments, as any similar room on this continent. All the lines in the office are worked from dynamotors, the power for running these machines being supplied by the Toronto Electric Light Company.

MR. A. B. SMITH,
Superintendent of Construction G. N. W. Telegraph Company, and Acting Chairman of the Local Committee C. E. A.

As Toronto is the headquarters of the company, and the Audit Department, Treasury Department, Stores Department, Construction and Maintenance Department, and Press Department are all stationed here, the entire force, including the operating staff, employed in this city by the G.N.W. is necessarily a very large one.

The Great North-Wertern Telegraph system now embraces 18,000 miles of poles and 42,000 miles of wire, with some 1,800 offices distributed throughout Ontario, Quebec, New Brunswick, Manitoba and a section of British Columbia.

C. P. R. TELEGRAPHS.

The C. P. R. Telegraphs is, as is generally known, a department of the Canadian Pacific Railway. The head office is in Montreal, Mr. James Kent being the general manager. The telegraphic business of the railway was established in 1886, since which time its growth has been very rapid. The Toronto office, naturally one of the most important, is situated in the Board of Trade building at the corner of Front and Yonge streets. Mr. A. W. Barber is superintendent of the Ontario division, and Mr. D. G. Sturrock local manager at Toronto. When the business was established seventeen years ago, it was handled by twelve wires and a staff of six operators, twelve messengers and four clerks. To-day thirty-six wires are required to handle the business, while the number of operators has been increased to thirty-five, the messengers to fifty, and the clerks to fourteen. As an indication of more recent development in the company's businesss, it may be stated that within ten years the traffic of the Toronto office has fully doubled.

The general offices and receiving room are located on the first floor of the Board of Trade building, and the operating department on the seventh floor. Messages are conveyed from the receiving offices to the operating room and vice versa by a pneumatic tube system operated by a "Roots" blower driven during the day by an engine in the building and when required at night by an electric motor. The operating room proper contains switch-board capacity for seventy wires and accommodation for seventy sets of instruments—eight quadruplex instruments being in use. Current for the wires and instruments is furnished by motor generators situated in a separate room. They are twelve in number, of the Lundell type, and were manufactured by the Sprague Electric Company, of New York. Connection is made by means of twelve 5-conductor cables (one cable to each machine) with the switchboard, which is bolted to a framework of angle iron secured to the floor and ceiling. On each side of the switchboard are the rheostats, one for each machine, while above are the ammeter and voltmeter, of Weston make. The current is obtained from the Toronto Electric Light Company, but there is also an emergency switch for connection with the electric plant at the Union Station in case the current from the Toronto Electric Light Company should fail. The generators are wound for 225 volts, the secondary rating being as follows: One of 110 volts, two of 30 volts, three of 130 volts, three of 225 volts, and three of 400 volts.

The generating plant was installed about three years ago, and replaced some 2,000 cells of battery required to operate the instruments and wires at that time. In the meantime additional quadruplexes have been added which would have necessitated increasing the number ef battery cells by about 1,000. The entire load is now taken care of with ease by the dynamo plant, which has also effected a large economy in space, occupying as it does only about one quarter that which had been taken up by battery jars.

The operating room now handles an average of 4,500 messages per day, in addition to from 60,000 to 70,000 words of press matter. This department is in charge of Mr. F. C. Robertson, circuit manager for the Ontario division. Mr. Robertson has acted in this capacity since the inception of the C. P. R. Telegraphs, previous to which time he was associated with the Dominion Telegraph Company, and later with the Mutual Union Telegraph Company and Postal Telegraph Company of the United States.

The city branch offices are forty in number, located in all sections of the city. A staff of line-men is kept constantly on duty for repair work, under the direction of Mr. E. A. Speer, foreman.

THE BELL TELEPHONE COMPANY IN TORONTO.

The Bell Telephone Company's system in Toronto is operated by means of three central offices, viz., the "Main," "North" and "Parkdale" exchanges.

The "Main" is situated on Temperance street, near Bay, in a three storey, fire-proof, brick building, which also contains the Toronto manager's and other local offices. The telephone lines enter the building underground in cables of from 50 to 400 pairs of wires each, which terminate in an iron distributing frame; all lines are protected from high potential or other dangerous currents by the usual combination of an air gap, sneak current and fuse protector. The distributing frame is situated on the ground floor, while the operating room and switchboard are on the second, connection between them being made by means of fine wire switchboard cables.

The switchboard is of the branch-terminal, self-restoring drop type arranged for about sixty subscribers' positions of eighty lines each, ten in-trunk positions, and twelve long distance positions, besides desks and tables for the chief operator, assistants, monitors, etc. This exchange has now about forty-five hundred subscribers' lines working in it, and has about reached its limit.

To take care of future development, land was secured immediately to the east of the old building in 1902 and an addition of about the same size as the original building erected, which addition is just nearing completion.

Here will be placed this year a switchboard of the most modern, common battery type, having capacity for eighty-eight hundred subscribers' lines. When this work is completed, all the Toronto offices will be run on the common battery system, the latest and most efficient scheme for central office operation yet devised.

The long distance system of the company centres in this office. Here terminate all the lines from outside of Toronto by means of which communication can be had with points in Canada as far distant as the shores of Lake Huron and Windsor on the west; Montreal, Ottawa, Quebec and the eastern townships in the east; as well as United States points, such as Chicago, St. Louis, Pittsburg, New York and Boston, with all intermediate stations.

The "North" office, located on Hayden street, near Yonge, is a two-storey, slow-burning construction, brick building erected in 1901. The lines enter the building in the usual manner by means of underground cables which terminate in protectors on the main distributing frame, switchboard frames connecting it to the intermediate frame and switchboard proper.

The switch is of the common battery or relay type, and differs materially from the "Main" switch. Miniature incandescent lamps, controlled by relays, take the place of the self-restoring annunciators and give great satisfaction, as they are easily seen, take up but little room and may be placed immediately above the jack with which they are associated, by so doing facilitating the operator's work considerably.

To signal the Central office, a subscriber merely removes the telephone from its supporting hook, when a lamp connected with his line at the Central office lights, drawing attention to that line; on the operator inserting the plug of one of a pair of connecting cords in the jack of the calling line, the lamp is extinguished. The operator after inquiring for the number wanted, completes the connection with the second cord. Associated with these cords are supervisory lamp signals, also controlled by the switch hook at the subscriber's station. If the cord is connected to a line and the telephone of that line is on the switch-hook, the lamp associated with the cord lights up, if the telephone is off the hook the lamp remains dark, consequently the operator has a positive signal in front of her as to the condition of the line, being able to tell at a glance whether a subscriber has answered a call, and whether a conversation is finished and the lines should be disconnected, or whether an error has been made and the subscriber requires further recognition. By means of these signals, a great deal of work is taken from the ear and given to the eye of the operator, a condition which telephone engineers are always striving to bring about, on account of the greater quantity and more efficient work which can be done by an operator.

This switchboard has a capacity for forty-two hundred lines, and has now about twenty-seven hundred lines working on it. There are also eight in-trunk positions to receive calls from other offices, and room for the extension of both these and the regular subscribers' positions.

Power to light the lamps, give current to the operators' instruments, and above all to those of the subscribers (for by this system local batteries are not needed) is derived from a series of eleven cells of storage battery of about 1000 ampere hours capacity. This battery is charged from one of two motor-generators, run from the mains of the Toronto Electric Light Company.

The "Parkdale" office is on Cowan avenue, near Queen street, and consists of one storey and a basement. The building is of brick and built on the slow-burning plan. The switchboard is similar to that of the "North" office, except that its capacity is for thirty-five hundred subscribers' lines, there now being about twelve hundred lines working in the office, which is being enlarged to take in an addition to the switchboard.

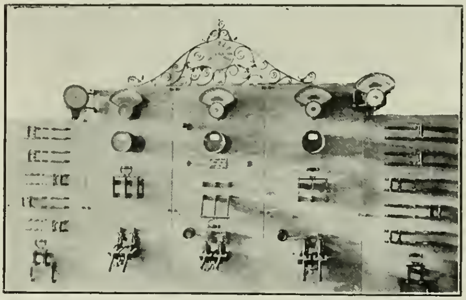
When this work and the new "Main" office installation is completed, Toronto will be one of the best equipped telephone exchanges in America, if not in the world.

BOARD OF TRADE SWITCHBOARD.

Herewith is shown an illustration of the switchboard manufactured by the Hill Electric Switch Company, Limited, of Montreal, for the Board of Trade Building in that city. This board was designed and constructed entirely by the above company, the consulting engineer giving them a free hand to produce an artistic, as well as a thoroughly mechanical and electrical job, the result being a board that has pleased both the consulting engineer of the Board of Trade, Mr. R. P. Southard, and the resident engineer, Mr. A. York.

The board is designed to handle the output of three multi-polar C. G. E. generators of 500 amperes, 110 volts, to run separately or in multiple. Provision is also made for current from the local lighting company, and all distributing switches are double throw, thus enabling current to be used from either sources at the same time, while a special single throw switch is connected to the D. C. bus-bars only, which controls a motor for freight elevator.

As will be seen, there are three generator panels, of blue Vermont marble, three feet wide, seven feet long and two inches thick, each fitted with I.T.E. circuit breakers, three pole 600 ampere switches of the well-known Hill type B, above which are recording watt-meters of the well known Scheeffer switch-board type, supplied by the Packard Electric Company, and above these again are illuminated dial, type K, Keystone ammeters.



Switchboard in Board of Trade Building, Montreal.

Each panel is fitted with a rheostat for field control, while the centre panel has a ground detector switch and lamp as well as a volt-meter switch which enables readings to be taken from any of the three generators as well as the A. C. bus-bars. Two swinging brackets are fitted to these panels, one holding a Keystone type K volt-meter, the other a Bristol recording volt-meter.

The center pole of the switches is fitted to an equalizer bar, the three switches being connected to the inner bus-bars, which are carried down to the inner terminals of the double-throw switches on the two distributing panels on either side of the generator panels. These double-throw switches are also of the Hill type B pattern, fitted with D. W. enclosed fuses.

Alternating current is taken in on an 800 ampere switch at bottom of distributing panel No. 1, carried up heavy bus-bars and across the board down the outside of No. 2, so that when switches are thrown out they connect with outside supply and when thrown in they connect with the generator supply.

A large wrought iron grille, with clock, crowns and whole, making a pleasing effect and showing the board off to good advantage.

QUESTIONS AND ANSWERS

"Reader": One of the bearings on our dynamo leaks oil badly; what is the best way to stop it? What is the object of painting the insides of bearings the way some of them are done?

Ans.—If the leak is through the joint of a split bearing hang something over the joint, such as a piece of sheet tin, soldered to the upper half, or chamfering the edges of the bearing will usually remedy the difficulty. If the oil is travelling along the shaft, it is found that a groove on the inside of the sleeve, about ¼ to ½ an inch wide, and about the same depth and distance from the end, together with one or two ⅜ to ⅝ drainage holes at the bottom of the groove, right through the bearing, are very satisfactory. Perhaps the shaft may be found with its shoulder rubbing tight against the bearing. This is occasionally the cause of oil throwing; the remedy is obvious, give the shaft some end play. The painting the inside of the bearings keeps sand and scale from loosening under the action of the oil and thus getting into it and the bearing, with the consequent liability to cutting and heating. It also tends to prevent the oil leaking through any small cracks or fissures which may originally exist in the casting.

"Superintendent": I have a direct current arc machine which is at present operating open arc lamps. Can I run enclosed lamps from it? If this is possible will it reduce the capacity? Can I run both open and enclosed from it at the same time?

Ans.—There is no difficulty in operating enclosed lamps from a machine built originally for those of the open type provided the amperage is not greater than about 6¾ amperes. Direct current enclosed lamps are not built for larger currents than this. The capacity in kilowatt or horse power output will remain the same, but as each enclosed lamp takes about 80 volts, as against 50 volts for the other type, the number of lamps you can operate is reduced in that proportion. You can run both open and enclosed lamps from the same dynamo, the amperage of both of course being the same, or if your open lamps are higher than 6¾ amperes, you can put a shunt round the enclosed lamps to take the extra current, though this is not a very efficient method.

"Mill Owner"—Which is the most preferable type of water wheel, the vertical with gears and pinions, or the horizontal direct coupled to the generator?

Ans.—It is impossible to say that one type or the other is better suited to any particular case without having full details regarding it. The first cost of the direct coupled type is usually greater than that of the other; the design does not lend itself so readily to the highest efficiency, and the range of speeds is limited in that those of the wheels and the generator must be the same. On the other hand, the absence of gears reduces the attendance required and the cost of repairs, besides eliminating the losses in the friction of the gears and the noise they make. There is also less likelihood of trouble from end thrust on the shaft. On the whole it is generally considered that the direct-coupled type is the more mechanical and neater unit, especially for the larger plants and those where reliability and continuity of service are of prime consideration.

"Railway Man": Is a street car controller built for say two 50 h.p. motors satisfactory for use with four motors of 25 h.p. each; (B) and is the reverse true?

Ans.—You cannot use a 2 motor controller to handle four machines because it is equipped with only two reversing switches, which means that the two motors forming one of the groups must have their fields connected permanently in parallel, and also their armatures. This will give you extremely unequal division of load between the two motors so connected, and prevent satisfactory operation. (B) You cannot run two 50 horse power machines from a four 25 horse power controller because, though the total capacity is the same, certain of the wiring, contact fingers, etc., would have to carry just twice the amperage they were designed for, and would probably get too hot, besides giving trouble from severe arcing and cutting.

"Dynamo": Can I use one wattmeter in measuring the power on both three phase and two phase circuits?

Ans.—If the load is the same on all the phases, and has the same power factor, one wattmeter will give correct measurements, the reading being multiplied by $\sqrt{3}$ or 1.733, in three phase systems, and by 2 in the other case. In addition to both these constants you would also have to use the dial constant. We presume you understand that there are meters made which are virtually two instruments in one case and which are specially for use on polyphase circuits, giving correct totals on one dial, irrespective of any unbalancing in the various legs.

"J. R. Y.": Does a direct current motor run faster or slower when it is hot than when it is cold, and why? What about an alternating motor?

Ans.—A direct current shunt wound motor runs faster when hot, due to the fact that the field resistance rises with the temperature and consequently the field current, and with it the field strength, falls. Series wound motors tend to run slower as they get hotter because of the increase in the resistance of both armature and fields. Alternating induction motors also act in the same manner, alternating synchronous motors keep a constant speed, or rather keep in step with the generator driving them, irrespective of their temperature.

"Engineer": I have an engine which occasionally gets a very hot bearing, and which cannot be shut down to cool it off. Can you give me any means of stopping it?

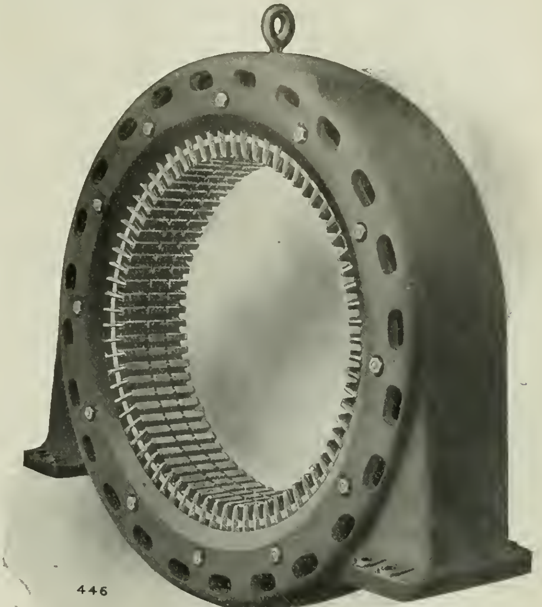
Ans.—We presume you mean some way of running the bearing without injury until it can be shut down and the seat of the trouble located, in which event we would say that if copious oiling, the application of lubricants like graphite, loosening the boxes, etc., will not stop the heat increasing, you might try a cold water hose running into the bearing, or ice on the box. Sometimes good results can be obtained by a small endless belt round the shaft close to the box, the lower end dipping into cold water. This last method has an advantage in that it makes less mess than some of the others.

"CECO" ELECTRICAL MACHINERY.

The Christensen Engineering Company, Milwaukee, has recently placed upon the market new lines of "Ceco" electrical machinery, including direct current motors and generators, alternators and transformers.

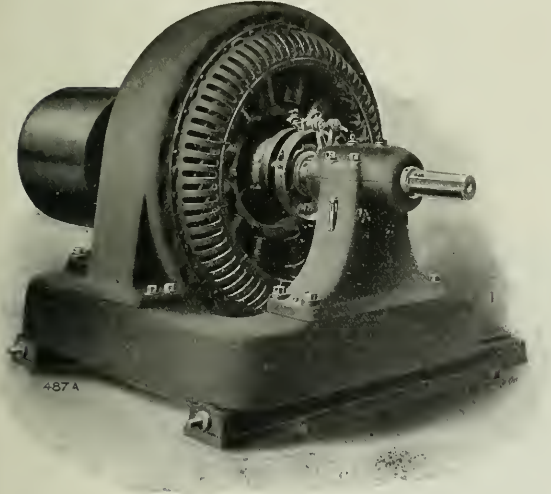
For several years this company has been manufacturing electric motors for driving air-compressors used in connection with the well known Christensen air-brake equipments on electric cars. More than 8000 of these motors are in highly satisfactory service throughout the world. The company has also built a large number of motors of various capacities for driving air-compressors used in general commercial service, and all the motors for driving machine tools and shafting in their own works. In order to manufacture this electrical apparatus, the company has maintained an extensive equipment, particularly suited to the purpose. Some time ago it was decided to greatly increase the company's manufacturing facilities, and to develop a complete line of electrical machinery of the highest grade.

The policy of the Christensen Engineering Company has always been not to place any apparatus on the market until the entire work of development had been satisfactorily completed. The exceedingly high reputation and remarkable success of the air-brake apparatus are highly due to this policy. Therefore the company has made no announcement regarding its electrical apparatus until the various lines were completely developed and severely tested. The results proved that these machines are in design, construction and performance worthy of the high reputation now accorded to the Christensen air brake equipments.



Armature Frame for Engine Type "Ceco" Alternator.

The company is now building machines for general power, railway or lighting purposes. The line of "Ceco" alternators, (Cut No.487A) ranging in capacity from 37½ to 1500 K.W., is illustrated herewith. All the "Ceco" alternators, whether belted, engine type or direct coupled, are of the revolving field type, thus leaving the armature stationary and easily accessible. By this form of construction the difficulties of properly insulating the armature coils, which have caused much trouble in rotating armatures, are eliminated.

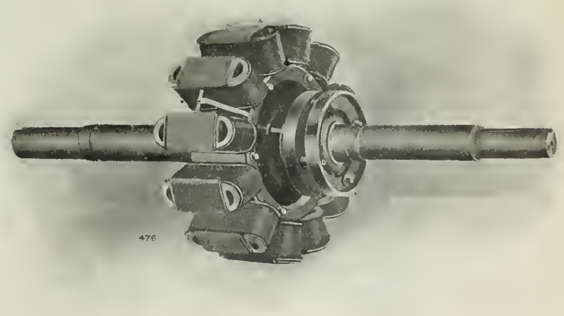


250 K.W., Belt Driven, Three-Phase "Ceco" Alternator.

The frame (Cut No. 446) consists of cast-iron housings, into which rings of laminated steel with inwardly projecting teeth are assembled, thereby forming slots for receiving the armature windings. The armature is designed with six slots per pole, so that it may be wound or rewound for single, two or three phase, as required. The armature frames for the belt driven alternators are cast in one piece, while the frames for the direct driven machines are divided horizontally. Instead of the usual practice of having several coils for the same machine, all the armature coils for each "Ceco" alternator are of the same size and shape so that they are interchangeable. The coils are specially insulated, so that they will stand without injury the highest temperature that will ever be reached in service. The ventilation of the armature is exceptionally good, ventilating ducts being provided at intervals in the core, assuring a good radiation of the heat generated. This is of great importance for preserving the insulation in the case of high tension machines.

The poles, (Cut No. 476), are built of laminated steel upon a cast iron spider, which is mounted upon a forged steel shaft. In the large sizes, the laminated poles are assembled upon a steel ring which is carried on the shaft by means of the cast iron spider. The individual poles are in all cases easily removable with their coils, without dismantling the machine. The field coils are composed of rectangular copper straps bent on edge. The collector rings are made of cast iron, and carbon brushes are used, thus reducing to a minimum the tension required, as well as the wear of the parts. Standard frequencies are 60 and 25 cycles per second. With the exception of the smaller sizes, "Ceco" alternators can be wound for any voltage up to 15000. The temperature rise, when running continuously with full load at any power factor, will not exceed 35° C. in the armature or 40° C. in the fields. At 25 per cent. current overload the corresponding temperatures will not exceed 40° C. and 50° C. The machines are all designed so that they will carry satisfactorily a 50 per cent. current overload for two hours at any power factor without injurious heating.

The company's works are extensive, and no expense was spared in providing every facility for the rapid, accurate and economical manufacture of their product. The equipment of machine tools, cranes, special machines, etc., is unusually modern and complete.



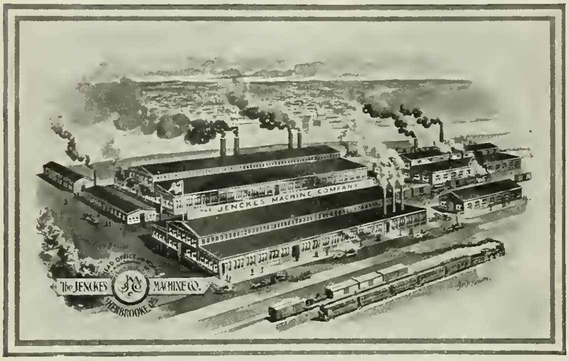
Revolving Field for Belt Driven "Ceco" Alternator.

A VISIT TO THE JENCKES PLANT.

[By Our Travelling Representative.]

The visitor to Sherbrooke, as he steps off the train at the Union Station, can scarcely fail to notice the long brick buildings of the Jenckes Machine Company, which cast shadows over the St. Francis river, but a minute's walk from the station.

Passing through Sherbrooke as I did, merely making a flying visit, I had not the time to spend that I would have liked, but I found sufficient to make a short visit to the shops of the Jenckes Machine Company, a company with the name of which, at least, most of the readers of the Canadian Electrical News are familiar.



The Jenckes Machine Company—Works at Sherbrooke, Que.

Entering the main office the hum of machinery became audible, and through a window in the partition I could see a portion of the vast machine shop interior, with the huge travelling crane in the distance.

One of the members of the office staff acted as cicerone for me, and together we entered the turbine department of the works. A number of turbines were in different stages of completion, some in cast iron, some in steel, and some in bronze, and my guide pointed to the far end of the shop, where four wheels of large size were being loaded on a car by the travelling crane. These, I was informed, were for the pulp mill of Mr. J. R. Booth at Ottawa, as were also 28 more of similar size. They were to develop some 9000 h.p., under a head of about twenty feet, and men were working on them night and day to get them completed.

An installation of wheels for a similar amount of power has recently been made by this company for the pulp mill of the Brompton Pulp and Paper Company, at Brompton Falls, Que., on the St. Francis river, some eight miles below Sherbrooke.

Two small wheels, 15 inches in diameter, caught my eye, and on enquiry I found that they were a special pattern, being built for the Dominion Bridge Company. Each wheel was of bronze, running in a steel case, and was of about half the capacity of the standard runner, developing 100 h.p. under a head of fifty feet, instead of 180 h.p. of the regular runner.

Orders are now under way, or nearing completion, for seventy-five Crocker turbines, and difficulty is found in getting work on them out fast enough to meet the demands.

The engine department, where the Jenckes-Corliss engines come from, was not as heavily pressed with work as the turbine section, although work was being pushed on a large Corliss hoisting engine for the Dominion Iron & Steel Company at Sydney, and a couple of other engines were on order.

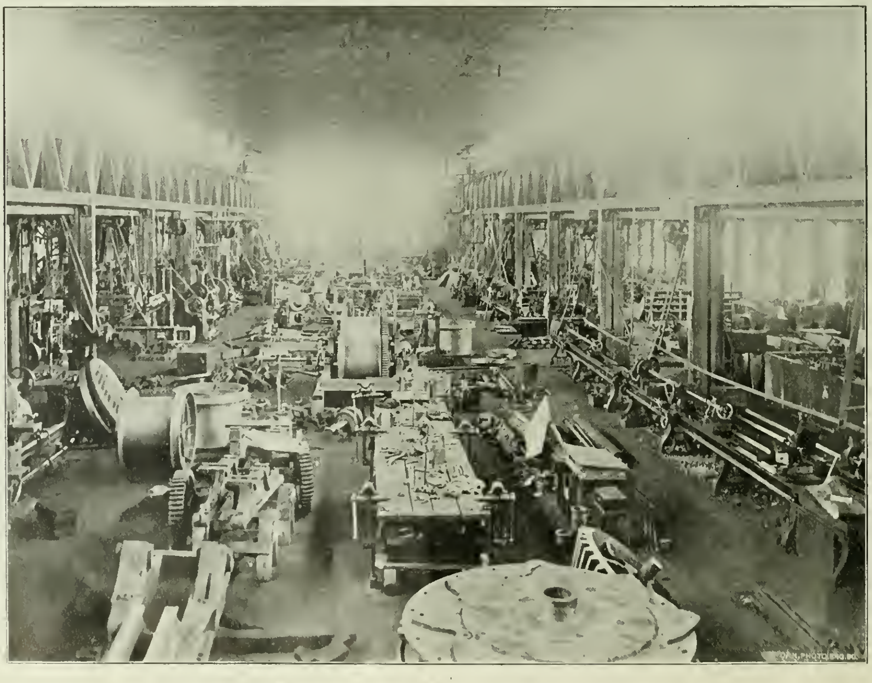
Passing through to the boiler shop, I found men working in the buildings, on cars and in the yard, in a labyrinth of steel penstocks of varying sizes, and amid a din of steel on steel that rendered talking useless.

We walked through the shops, and I noticed half a dozen large boilers, seven feet in diameter, nearly finished apparantly, and when we reached the open air, where I could hear my informant, he stated that there were then twenty-five or so boilers on order, from seventy to two hundred h. p. and carrying a working pressure of from 100 to 150 lbs. steam.

Nearly a full half mile of steel penstock, ranging in size from eight to sixteen feet in diameter, was being made and set up by workmen from the shops of the Jenckes Machine Company, the territory extending from Nova Scotia to Western Ontario, and most of the penstock work being to supply water to Crocker turbines.

The departments for machinery for the development of electricity naturally interested me most, but in passing through the foundry, a large brick building, some eighty by three hundred and forty feet, I saw an electric crane swing up the pattern for the large crusher made last fall for the Granby Smelter in British Columbia. There was, it may be remembered, considerable newspaper mention made at the time about the size and weight of that crusher, weighing, as it did, 113,000 lbs., and being, so far as is known, the largest crusher in the Dominion. Its capacity is 1500 tons of ore per ten hours, and a letter from the superintendent of the smelter, which I saw, stated that so far they had been unable to bring ore enough to the crusher to run it to its full capacity.

I might continue, and mention the other mining machinery, the pulp mill and saw mill machinery of various kinds, which keep over 400 men working, but lack of space forbids.— J. R. H.



The Jenckes Machine Company—A Portion of the Erecting Floor.

ANTI-FRICTION BEARINGS.

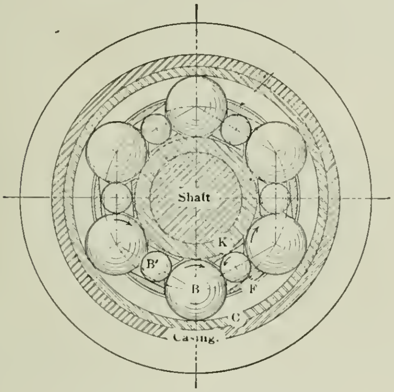
Electrical men and engineers generally are now beginning to turn to the great frictionless bearings. "To reduce friction is to create power." This saying is well-known to all, and, while in the past the pulleys and the belts have been receiving attention, we are now beginning to get something as "frictionless as the wheels of the universe."

Of roller and ball bearings now prominently before the Canadians, the principle ones are the Chapman Double Ball Bearings, the Henderson Roller Bearings and the Hiatt Roller Bearings.

The Chapman double ball bearing is the invention of Mr. C. H. Chapman, and it has already begun to change the system of transmitting power. A visit to the Chapman Double Ball Bearing Co.'s office at 39 Scott street, Toronto, shows a splendid demonstration of the great merits of this invention. The discovery was almost by accident. A trial of the ball bearings and a track record lowered.

All these bearings are for the purpose of reducing friction in all moving parts of machinery. Friction is the bugbear of manufacturers and owners of rolling stock and the devourer of dividends.

By referring to the cut below it will be seen that B is the load-carrying ball, B′ the idler ball, F the retaining float for B′, C the cup and K the cone. The idler B is so placed that its centre is coincident with a line connecting the centres of each of the adjacent carrier balls B, and is positively held in position by a loose free ring F that floats with the carrier balls and is supported on the cone or shaft but not in contact with any of the balls when the same are under load, during which time the idler balls are maintained in the same relative position by rolling contact with the carrier balls.



The Chapman Double Ball Bearings.

Electric street railway men are interested in the Chapman double ball bearings because it has been demonstrated successfully that they will stand up under weight when applied in accordance with the ideas of the invention, which bearings are now in use and giving perfect satisfaction.

In the Orswell Mills, at Fitchburg, Mass., 300 feet of line shafting, equipped with these bearings, running at a speed of 600 revolutions per minute, has been in operation two years without lubricant and without any sign of wear. The load on this was 125 h. p. The saving in power here was 23½ per cent.

The Minister of Railways and Canals has authorized the equipping of one of the express passenger trains and engine on the Intercolonial Railway with the Chapman apparatus. Plan of this is on exhibition at the company's office.

The illustration upon another page of a street railway car equipped with these bearings will be noted by our readers. This car has been in use for over a year and a half and in a recent examination by Mr. Muhlfeld, the Mechanical Superintendent of the Intercolonial Railway, no sign of wear or heat whatever could be found in the bearings. It has been examined and tested by the best experts and has shown a saving in power of over 60 per cent., and this without any lubricant.

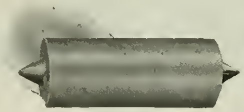
One of the gravest problems involved in the steam turbine or rotary engine has been that of a proper bearing for the extremely high rotative speed of the main cylinder shaft. The shafting of a Parsons steam turbine on one of the Warren Line steamships by the use of the Chapman double ball bearings showed a remarkable demonstration in their favour. From a defective service of 3600 revolutions per minute using a great quantity of oil, the Chapman bearings run the turbine 4200 revolutions per minute and no oil used. An emery grinder spindle has been run daily for over a year at a speed of 1600 revolutions per minute, no oil used, and are as perfect to-day as ever.

A visit by our representative to the Henderson Roller Bearing Mfg. Co.'s Works at 66 Esplanade W., Toronto, revealed a very busy hive of industry. Here is employed nearly fifty men in the three storeys of the large factory. The different parts of the Henderson roller bearings are here seen in the various stages of manufacture.

The large gas and coal furnaces used to harden the castings are running full blast, turning out hundreds of these bearings to fill the orders already in hand.

The place is well worthy a visit from visiting electrical engineers or others interested in roller bearings.

A visit to the head offices of the Henderson Roller Bearing Co. in the Temple Building gave an opportunity to see the various models and roller bearings, the invention of Mr. Henderson, a Canadian. These bearings have already attracted world-wide interest and the success of the company was from the very first an assured fact.



Roller.

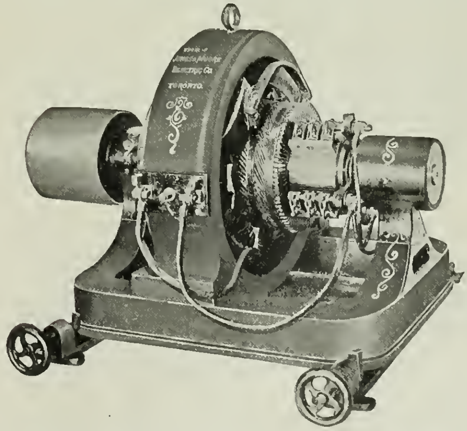
Ball.

The Henderson Roller Bearing is one of the most satisfactory anti-fricton bearings ever presented to the public. The rollers are held in alignment with the minimum amount of friction, and the end thrust is provided for by an almost frictionless, yet durable means. Bearing surface is provided proportional to the weight to be carried, so that no indentation of the metal occurs. By referring to the cut on this page the relative bearing surface of the ball and roller will readily be seen.

Up to the present time the railroads have been using the ordinary brass journal for their rolling stock, and considerable difficulty has been met with because of hot boxes, while in frosty weather the congealing of the oil increases the friction, and thus lessens the hauling capacity of the engine. The use of roller bearings is particularly adapted for railroad purposes.

The wonderful saving in power of the Henderson roller bearings has been demonstrated. With a weight of 64 tons upon the ordinary brass journal 3200 lbs. power was required to start it in motion, 2012 lbs. was required to keep it running, while with the bearings only 960 lbs. was required to start it and only 300 lbs. to keep it in motion—an average saving of more than 75 per cent. of power. A compressed air engine now accomplishes work with a pressure of 25 lbs., which on the ordinary journal requires 110 lbs. pressure to do the work. This table has been in constant use for ten months carrying up to 95 tons at times, requiring no oil and no attention.

The above shows the bearings as put to a severe test upon an electric generator revolving at a rate of from 1000 to 1200 revolutions per minute and carrying a load equal to 60 h. p. At the company's office is a splendid test of the end thrust bearing, used in conjunction with the rollers. 1100 pounds weight can be easily turned with the thumb and finger at the center of the hub.



Electric Generator Fitted With Roller Bearings.

This is also adapted for upright shafting, centrifugal bearings, boat propellers, &c.

In this age, when so many of our factories are run by electric power, the reduction of the friction in shalting has become a very important consideration.

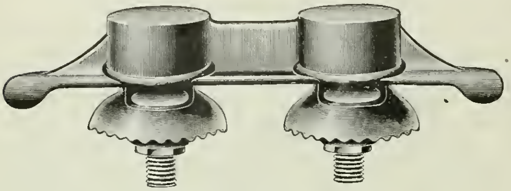
The adoption of ball or roller bearings generally will mean a saving of from 50 to 75 per cent. in power in the factories of our country. It is to be hoped that Canada will utilize this great invention and develop her growing industries.

J. R. H.

GREAT NEW ENGLAND SUPPLY HOUSE.

The tremendous growth in the application of electricity, or rather in the use of electrical appliances, is nowhere more apparent than in the spacious store and ware—rooms of the Stuart-Howland Company at Boston.

A little more than three years ago this company was organized and started business with a comparatively small but well selected stock of lighting supplies. Within a few weeks the agency for the well-known Russell-Tomlinson telephones was secured, and a telephone department added ; then seeing the urgent demand for street railway supplies several agencies of well-known manufacturers were secured ; a stock was purchased and a street railway department opened. New salesmen were added frequently, in fact we are told that whenever a specially able salesman applied for a position he was promptly engaged and a place made for him.


Gun Type, Straight Line Suspension.
Stuart-Howland Company, Manufacturers.

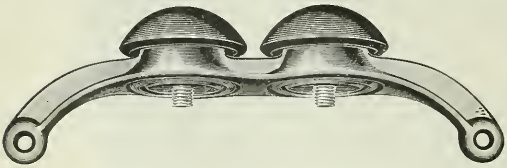
Orders came pouring in, especially in the street railway department, and the manufacturers were unable to fill orders promptly ; customers clamored for their goods. The company, not to be outdone, secured the services of some well-known engineers and set to work to design ad manufacture a complete line of overhead and pole equipment. Having the benefit of the experience of other makers the designers were able to avoid weakness in construction and yet not increase the aggregate weight.

The result of their work is shown in six different types of overhead insulation, 12 types of bracket arms, 15 or 20 of ears, and as many more of trolley wheels, as well as a great variety of other appliances used in the construction and maintenance of street railways.

The entire line is symmetrical, substantial,and carefully made. In proof of this the company claim that although last year they sold and delivered over 1000 miles of complete overhead and pole equipment (excepting wire) of their own manufacture, all of which was fully guaranteed, not one complaint was received,nor was one piece returned as defective.

Being unable to take care of all their orders last year, and to avoid a repetition this year, they have been making up stock during the winter. They have now on hand and ready for shipment 18,000 bracket arms, also hangers, globe strains, ears, trolley wheels, signal strand, cross arms, cross arm braces, etc., in like proportion.

The business of this company has grown from a small beginning three years ago to be one of the largest of its kind in the world, with branches in New York, Cleveland, London and Paris. Their stock at Boston includes practically everything electrical, and all standard lighting, telephone and street railway supplies are carried in large quantities. Some of the company's specialties are illustrated on this page.


Cap and Cone Type, Double Curve Suspension.
Stuart-Howland Company, Manufacturers.

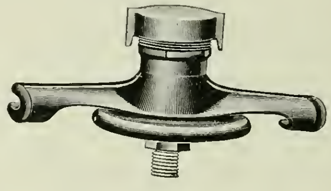
The Vancouver Electrical Works, of Vancouver, B. C., intend to build direct connected marine outfits up to 150 lignts capacity. The manager is Mr. J. Shipton.

TELEPHONE COMPETITION.

A committee was appointed by the city council of Hamilton to visit several American cities in quest of information as to telephone competition. This committee recently made its report, which contains is summed up in the following conclusions : " It is not desirable for any community to have competition in telephones unless it is to regulate some very grave evil. The almost universal experience has been that competition raises the rates materially to business and professional men, and lowers the rate somewhat to a resident. Competition in ordinary lines of business may be a good thing, but your committee is of the opinion that in telephony the rates should be regulated by some other means, competition being costly and up to the present time somewhat in the nature of an experiment. Government ownership of the telephone trunk lines, with local ownership of the local lines, would be one solution of the difficulty, and probably the very best solution. Absolute government control of all telephone lines would be another solution. Government control of the rates would probably be the most natural solution of the present state of affairs in Canada. If the government controlled the trunk lines, the municipalization of the local lines would be a comparatively simple matter, but with the trunk lines in the hands of the Bell Company, and also the local lines in the hands of the Bell Company, the installation of a municipal plant would be merely the introduction of competition."

RUNNING A GAS ENGINE.

In starting and running a gas engine there are several points which the attendant must look out for. An oil cup may run dry or get stopped up. A lock nut may work loose on a valve stem and, if not looked after, may wear off the cotter pin above it and allow the valve to drop into the cylinder. An ignitor wire may work out of the terminal nut and become grounded, thereby shutting down the engine. This last would not happen if the set screw in the terminal nut had been clamped down on the wire. A trip stem nut may work loose, so as to prevent contact taking place between the points of that ignitor, thus causing the cylinder to miss fire, or it may move in the opposite direction till it allows the points to remain permanently in contact, thus short-circuiting the other ignitors and causing a shut down.


Boston Type, Straight Line Suspension.
Stuart-Howland Company, Manufacturers.

An advantage of a two or three cylinder engine is that a failure of one cylinder does not cause the engine to stop, and many small derangements may be cured while running. An exhaust valve may leak and need grinding. An agitator may become grounded by moisture or carbon. A battery may become exhausted and need renewal. A bearing may need keying up. Backfiring is the ignition of the explosive mixture before it has entered the cylinder. A sharp explosion and a jet of flame from the air inlet usually accompanies it. That may be caused by a bad mixture of gas and air, burning so slowly that flame hangs in the cylinder during the whole of the expansion and exhaust stroke, thus igniting the incoming gases when the valve opens. Or more rarely, a leaky inlet valve may allow the explosion flame to shoot into the mixture outside and ignite it. Backfiring should be cured, for it checks the speed of the engine and sooner or later necessitates new inlet valve springs. By driving the inlet valve down till the spring comes solid it often wedges one coil sideways over another, thus crushing them together and decreasing the lifting power of the spring.

The power plant at Ragged Rapids, owned by the town of Orillia, Ont., has been assessed for $25,000 by the assessor in Matchedash. The town has entered an appeal on the ground that the property of one municipality is not taxable in another municipality.

SPEED OF MOTOR VEHICLES.

A bill has been introduced in the Ontario Legislature by Mr. Preston to regulate the speed and operation of motor vehicles on highways. It provides also for the payment to the Government of a nominal registration fee. The provisions as to speed are as follows:

No motor vehicle shall be run upon any public highway within any city, town or incorporated village at a greater rate of speed than ten miles an hour, or upon any public highway outside of any city, town or incorporated village at a greater speed than fifteen miles per hour, unless authorized to do so by by-law of said municipality.

No person shall drive a motor vehicle upon any public street, public highways, public roads, parks, public parkways or public driveways in this province in a race or on a bet or wager.

Every person having control or charge of a motor vehicle shall, whenever upon any public street or way and approaching any vehicle drawn by horse or horses or any horse upon which any person is riding, operate, manage and control such motor vehicle in such manner as to exercise every reasonable precaution to prevent the frightening of any such horse or horses, and to insure the safety and protection of any person riding or driving the same. And if any such horse or horses appear frightened the person in control of such motor vehicle shall reduce its speed, and if requested by signal or otherwise by the driver of such horse or horses, shall not proceed further towards such animal, unless such movement be necessary to avoid accident or injury, or until such animal appears to be under the control of its rider or driver.

Upon approaching a crossing of intersecting ways, and also in traversing the crossing or intersection, or in crossing a bridge, the person in control of a motor vehicle shall run it at a rate of speed less than that specified, and not greater than is reasonable and proper, having regard to the traffic and use of the intersecting ways or bridge.

CARE OF A GAS ENGINE.

There are a number of little things that may happen to a gas engine which the attendant must look out for. An oil cup may run dry or get stopped up. A lock nut may work loose on a valve stem, and, if not looked after, may wear off the cotter pin above it, and allow the valve to drop into the cylinder. An igniter wire may work out of the terminal nut and become grounded, thereby shutting down the engine. This last would not happen if the screw in the terminal nut had been clamped down on the wire. A trip stem nut may work loose, so as to prevent contact taking place between the points of that igniter, thus causing the cylinder to miss fire, or it may move in the opposite direction until it allows the points to remain permanently in contact, thus short-circuiting the other igniters and causing a shut-down.

An advantage of a two or three-cylinder engine is that a failure of one cylinder does not cause the engine to stop, and many small derangements may be cured while running. An agitator may become grounded by moisture or carbon. A battery may become exhausted and need renewal. A bearing may need keying up.

Backfiring is the ignition of the explosive mixture before it has entered the cylinder. A sharp explosion and a jet of flame from the air inlet usually accompanies it. That may be caused by a bad mixture of gas and air burning so slowly that flame hangs in the cylinder during the whole of the expansion when the valve opens. Or, more rarely, a leaky inlet valve may allow the explosion flame to shoot into the mixture outside and ignite it.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, June 1, 1903.

The Montreal Railway employees who struck about three months ago did so well that they thought they would repeat the dose and struck again just before the holiday (Victoria Day.) Luckily, the street railway decided that they had had enough nonsense and fought the strike to a finish. There are a few motormen and conductors now looking for a job and some others gracing the common jail as the result of intimidation and violence. The public were justly incensed against the strikers and patronized freely the cars run by non-union men. Although the average business man would as leave "loaf around the house" on a holiday, the ladies and children who usually take a run out to the suburbs were greatly inconvenienced. A prominent official of a Trades Union was heard to remark that he had long advocated a Canadian Union, and that this was the first blow and a heavy one to the International.

The honors were carried off by Mr. W. G. Ross, Secretary-Treasurer of the Montreal Street Railway, who stood to his guns and would brook no interference from either unions or conciliators, either of the aldermanic or Mulock variety. Mr. Resin Orr represented the Yankee end of the stick and has lost both ways. "Resin" is said to be a semi-transparant and rather brittle substance; so his "strike" and "International" got broken, and the majority of the men have seen through the little game of sending their money to the United States to help Waterbury, Bridgeport, and other strikes.

Now that business is again normal, Mr. W. G. Ross promises the men a substantial subscription to their Mutual Benefit Society, which it is understood they are now forming; and will not allow any vindictive feeling to be shown the strikers, who have seen the error of their ways and are back on duty.

The Electrical Workers Union declared a strike about May 23 on the Montreal Light, Heat and Power Company affecting about one hundred employees, chiefly line men. As the manager had repeatedly stated that he would meet a deputation of bona-fide employees, and would not treat with the union as a union—the more especially as it is practically a branch of a U.S. organization—many of the men can blame themselves if they find it impossible to get their positions back again later. Everything points that way now.

The City Council have brought up the underground conduit question again, claiming that owing to the amalgamation of the companies there would now be no divergent interests, and that if such were built by the city and leased it would bring in a "handsome" revenue to the city. The word "handsome" sounds as it it were intended to bleed the electric companies to provide the city with revenue, and spoils the whole preamble. The need of such a conduit is obvious to any person, and the argument of one common interest is also good; but if it is going to mean extortionate rentals they will find a surprise party in the shape of considerable opposition, not to speak of the franchises granted by the legislature.

Mr. Chas. Morton, manager of the Standard Light and Power Company for many years, has severed his connection since consolidation. Mr. Morton's regime was successful, the balance sheet showing on the right side, and many of his old customers will miss the well known face when they go to transact their business. The accounting department for the Standard Company is already turned over, and bills are now payable to the Montreal Light, Heat & Power Company.

SPARKS.

The Council of Windsor Mills, Que., have decided to install a municipal electric light plant.

The Bell Telephone Company have built two copper metallic lines between Magog and Georgeville, Que.

The New Brunswick Telephone Company have decided to install a telephone exchange at St. Andrews, N. B.

The town of Sackville, N. B., proposes to issue debentures for the purpose of purchasing the electric light plant.

The Ottawa Electric Railway Company has a bill before the Legislature increasing its borrowing powers to $1,000,000.

An act has been introduced in the Ontario Legislature providing for the extension of the Guelph Street Railway and for changing the name to the Guelph Radial Railway.

The International Carbon Company, of Toronto, has been incorporated, with a capital of $15,000, the provisional directors being Messrs. George J. Castle, S. W. McKeown and J. J. Seitz.

The Chippewa Electric Company, the purchasers of the Algoma Electric Company's stock and business at Sault Ste. Marie, have secured the contract for wiring the new Grand Trunk freight sheds at North Bay.

The Whitney Electrical Instrument Company, of Concord, New Hampshire, recently lost almost their entire plant by fire. It is understood that arrangements have been made to rebuild immediately.

Mr. J. W. Nesbitt, K. C., solicitor for the Hamilton, Caledonia & Lake Erie Railway Company, says the construction of an electric railway will be commenced as soon as sufficient stock is subscribed.

Mr. A. Heathcote is in charge of the engineers who are surveying for an electric railway to extend from Winnipeg to Selkirk, Man. The capitalists behind the scheme belong chiefly to Winnipeg.

The town of Lucknow, Ont., will likely purchase the electric light plant from the owners and install a modern system. Mr. H. F. Strickland, electrical engineer, of Toronto, has the matter in hand for the town.

Mr. H. P. Dwight, general manager of the Great North-Western Telegraph Company, Toronto, recently returned from New York, where he conferred with the Western Union Telegraph Company in respect to proposed extensions.

Mr. Michael Connoly, of Montreal, has secured the contract for the completion of the works of the North Shore Power & Railway Company at Seven Islands, Que. The contract includes the building of a railway, wharves, pulp mills, etc.

Clarkson School of Technology Thos. S. Clarkson Memorial, Potsdam, N.Y.

Courses leading to degrees of Bachelor of Science in Civil, Electrical and Mechanical Engineering, comprising four years of thorough training and resident collegiate work in theory and practise of engineering. Well equipped shops, laboratories, drafting rooms and power plant. Located near Massena and the engineering developments along the St. Lawrence River. Healthful climate. Tuition moderate.

WM. S. ALDRICH, Director

ELECTRICAL REPAIRS

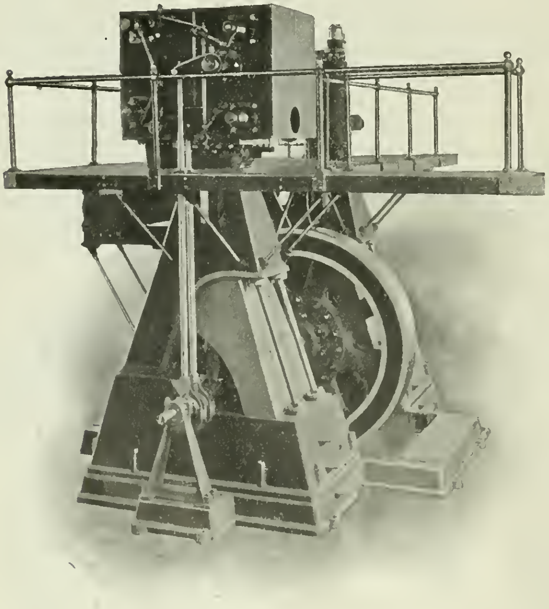
In the large and well equipped factories where the manufacture of electrical apparatus is carried out under the piece work system, they find that repair work or apparatus sent in to be repaired or rewound interferes with this system, and in many cases they would prefer not to do this kind of work, as it is almost impossible to do it with dispatch and at a reasonable price. Knowing the above to be a fact,

MESSRS. FRED. THOMSON & CO.

774 Craig Street, MONTREAL, P.Q.

have arranged their works for repair work only. They keep armatures of nearly all makes of dynamos in stock, which they loan while repairs are being made. Their factory is so arranged that they can run night and day, and work can be finished in the shortest possible time. **Telephone Main 3149.**

HE LAURIE ENGINE COMPANY
MONTREAL, CANADA.



500 P. H. Laurie Vertical Cross Compound Electrical Engine.

Some Laurie Corliss Installations:

British Columbia Electric Ry. Co.	2,100 H. P.
Winnipeg Electric Street Ry. Co.	2,200 H. P.
Toronto Electric Street Ry. Co.	1,500 H. P.
Montreal Street Railway Co.	11,500 H. P.
Dominion Iron & Steel Co.	2,400 H. P.
Cape Breton Electric Tramway Co.	1,200 H. P.

LAURIE CORLISS ENGINES

UNAPPROACHED FOR ECONOMY, EFFICIENCY OR REGULATION

THE CANADIAN CASUALTY & BOILER INSURANCE COMPANY.

This company, as its name implies, has been founded for the purpose of a general accident business as well as boiler insurance and inspection, and has in the short time of its existence already established itself well in the insurance world. This is scarcely to be wondered at in view of the fact that the directors of the company have spared no endeavors to make the staff of the company a thoroughly competent and efficient one. The managing director, Mr. A. G. C. Dinnick, himself a man of great business experience and ability, has a special gift of choosing good men for the various departments of his institution. The chief engineer of the company, Mr. A. M. Wickens, is a gentleman without a peer in his profession. Until recently he held the position of chief engineer of the Public Works Department of the Ontario Government, as well as Inspector of Boilers in the Government Institutions. He resigned this position in order to accept the appointment offered to him by the Canadian Casualty and Boiler Insurance Company as their chief engineer. With an expert like Mr. Wickens at the head of the engineer's department it is safe to say that the interests of the insurers will be well looked after, as everybody knows how important is periodical inspection by a competent and experienced engineer. As an engineer erecting and operating steam plants, Mr. Wickens brings expert practical knowledge to bear upon his deliberations as chief of the engineers' department of the Canadian Casualty and Boiler Insurance Company.

The efficiency of the engineers' department enables this company to extend its operations in a way few other companies can follow. The company is in a position to give expert advice upon the erection of any kind of steam or electrical plants, a feature which interested parties will presumably be quick to take advantage of.

The public have been quick to recognize the advantages offered to them by this company, and the amount of policies written is the best proof of this contention. With the energetic management and the practical knowledge combined, the Canadian Casualty and Boiler Insurance Company is sure to take a leading place in its class of business in the very near future.

Mr. A. M. Wickens,
Chief Engineer The Canadian Casualty & Boiler Insurance Company.

Mr. A. G. C. Dinnick,
Managing Director The Canadian Casualty & Boiler Insurance Company.

WE BUILD

Switchboards and Panel Boards

SEND US YOUR SPECIFICATIONS

We also manufacture a full line of Knife Switches, Time Switches and the Hill Automatic Switch

The Hill Electric Switch Co., Limited, 426 St. Paul Street
MONTREAL

TRADE NOTES.

J. C. Wilson & Company, Glenora, Ont., have under construction two 33-inch vertical "Little Giant" turbines for Stuart Bros., Mitchell, Ont., who are making some improvements in their flour mill.

The two 600 h. p. vertical cross-compound engines which the Robb Engineering Company are supplying for the Nova Scotia Steel Company's plant at Sydney Mines will be fitted with the new Armstrong Corliss valve gear and Robb governors. The engines are to be direct connected to Canadian General Electric generators.

J. C. Wilson & Company, Glenora, Ont., announce the following recent shipments of "Little Giant" turbines. Note their destination and you will see how fully they cover the country—Wm. Henstridge, Notch Hill, B. C., a 6-inch vertical; Jno. Warcup, Lemisurier, Que., a 16-inch vertical; J. H. Mullen, Bear River, N. S., a 12-inch vertical; Frank Saunders, Gander Bay, Newfoundland, an 18-inch vertical.

PUBLICATIONS.

The General Electric Company have issued a neat booklet descriptive of the various types of fan motors.

Messrs. James Hope & Sons, of Ottawa, have issued a new publication entitled "The All-Red Line," the editor of which is Mr. George Johnson, Dominion Statistican. The design of the publication is two fold, 1st, to place on record in a convenient form the annals of the Pacific Cable project in which from first to last Canada has taken such a conspicuous part; and secondly, to educate and mould the public mind in all the King's possessions around the world in respect to a much larger subject in which Canada with the whole Empire is immensely interested.

SPARKS.

The electric railway from Brantford to Paris, Ont., was opened on May 12th. The fare for the round trip is thirty cents.

By a vote of 79 to 1 the ratepayers of Gravenhurst, Ont., have decided to purchase the electric plant from the Gravenhurst Electric Light Company.

Mr. Judd is actively pushing the preliminary arrangements for the construction of an electric railway connecting Kingston, Gananoque, Perth, and Lanark. The line would be 47 miles in lengtht and would cost about $10,000 per mile.

A new system of telegraphy has been tested between the post offices of London and Glasgow. By the new method twelve messages can be sent over the same wire simultaneously, and the number can be doubled by the duplex method of transmission.

Port Colborne and Thorold parties have asked the Dominion Government to incorporate the Erie Ontario Power Company, The bill is being opoosed by the Hamilton & Lake Erie Power Company, on the ground that the proposed field of operations is the same as that covered by their charter obtained about two years ago.

SWEDISH CHARCOAL IRON SHEETS, BARS, RODS, STRIPS AND STAMPINGS.

TURNER BROS., 134 UPPER THAMES ST., LONDON, ENG.

Magnet Forgings, Slabs, Bars in the Rough and Machined.

Telegraphic Address, 'SHEETIRON', LONDON. ESTABLISHED 1870.

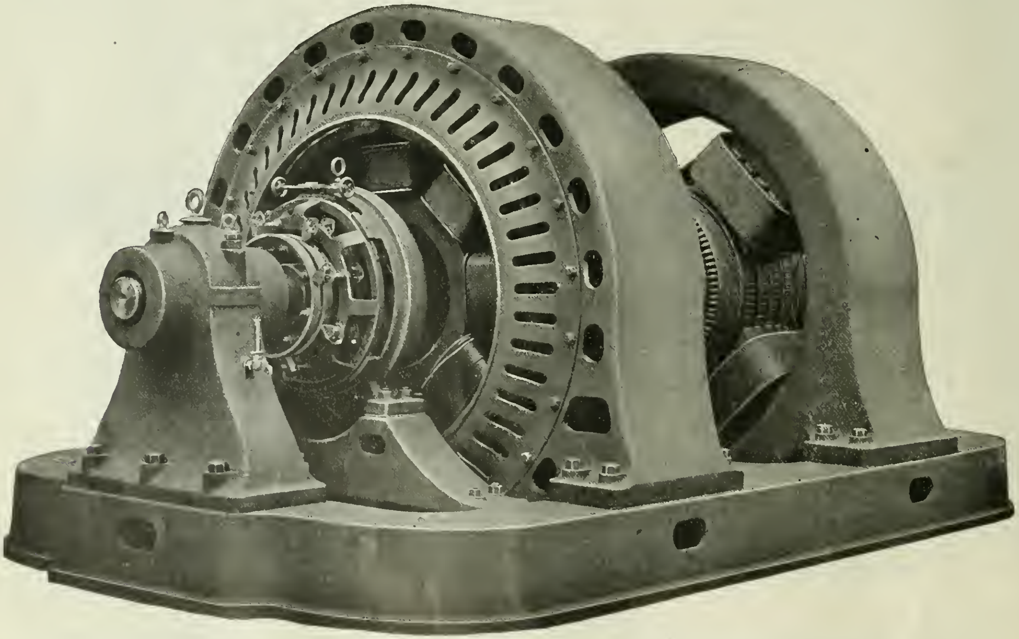
Discs over 5 feet diameter and Plain Circles Sheets up to 66 in wide.

MILD STEEL CASTINGS FOR MAGNETS MAGNET STEEL FOR TELEPHONES

Sole Representatives for Canada: Peacock Brothers, Canada Life Buildings, Montreal.

Dick, Kerr & Company

LIMITED



Head Office: 110 Cannon Street, LONDON, E. C, ENGLAND
Canadian Agent's Office: 332 King Street, KINGSTON, ONT.

WINDING OF WESTINGHOUSE TRANSFORMERS.

Oil-insulated self-cooling transformers may be wound for practically any voltage desired. The following high tension voltages, however, have been adopted as standard: 2200, 6600, 11000, 16500, 22000, 33000 and 44000. Taps are brought out from the high tension winding for three lower voltages. This provision makes it possible to use duplicate transformers at both ends of the transmission line, the taps on the lowering transformers accommodating them to the reduced line voltage. The following table shows the exact voltages for which Westinghouse standard transformers are wound:

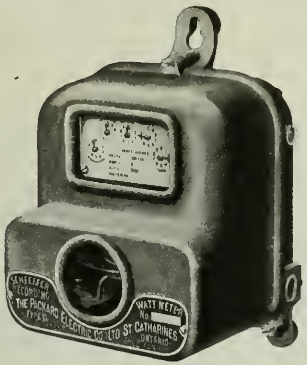
Standard Voltages for Oil-Insulated Self-Cooling Transformers.

2200	6600	11000	16500	22000	33000	44000
2100	6300	10500	15750	21000	31500	42000
2000	6000	10000	15000	20000	30000	40000
1900	5700	9500	14250	19000	28500	38000

Transformers of a capacity not exceeding 150 k. w. may be wound for voltages as low as 50, and the larger transformers for voltages as low as 100. Either or both windings may be divided into two equal parts so arranged as to permit either series or multiple operation, the change being effected by a simple rearrangement of connectors on the terminal block. Taps may be brought out from the low tension winding for ample variation in both voltage and ratio, and are provided for a total of five voltages, full voltage, 5 per cent. and 10 per cent. less than full voltage, half voltage, and 5 per cent. less than half voltage.

As showing the remarkable extension of street railways and electric railways in the United States, the census preliminary report of that country on that subject is eloquent. It shows that in the last ten years their mileage has increased 187.85 per cent., the number of passengers carried 137.94 per cent. The number of miles operated by animal power shows a decrease of 95.42 per cent., 259 miles being so operated at the present time.

Packard Type "G" Recording Watt Meters



The immense number of orders we have filled in the past 18 months for this meter illustrated here is ample proof of its superiority.

It is unquestionably the most sensitive meter on the market as well as the fairest to both consumer and central station, and station managers who desire pay for all current consumed and no more will do well to investigate the merits of type "G".

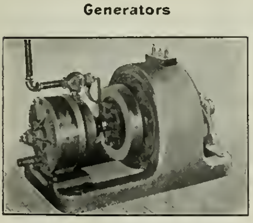
Its sensitiveness can be no better illustrated than in the fact that it will measure the current consumed when a Hylo Lamp is burning on its baby filament.

The Packard Electric Co., Limited,
Montreal St. Catharines

INDEPENDENT UNITS

For your FACTORY, your SAWMILL, your STORE, your YACHTS and your STEAMERS, your COUNTRY-HOUSE or your HOTEL.

Direct Current Multipolar Generators



Direct-Connected to a throttle-governed Sleeper Engine.

The armatures will not heat.
The commutators will not spark.
The control is automatic, there is no fluctuation of light.
Taken altogether they are the most efficient and the most perfectly automatic units ever offered.
Compact and light—space and weight minimized.

Write us for particulars, catalogs and prices.

The SLEEPER ENGINE COMPANY, Limited
Office and works, corner Darling and Notre Dame Streets, Montreal

LEGAL DECISIONS.

OTTAWA ELECTRIC COMPANY VS. BIRKS & SONS.-This was a test case wherein the Ottawa Electric Company wished to ascertain whether the contracts, which are made with customers, are equally binding upon their custmers as upon the company. In this case Messrs. Birks & Sons had had some negotiations with the company with a view to some changes in the arrangements and on this account held that the contract had been voided and that it was otherwise informal. The court sustained the company's claims, and there will now be no doubt as to their ability to enforce the contracts which are made with customers.

OTTAWA ELECTRIC CO. V. CITY OF OTTAWA.—A. B. Aylesworth, K. C., and T. McVeity (Ottawa), for defendants, appealed from judgment of Boyd, C. (1 O. W. R. 508), allowing appeal of plaintiffs and dismissing appeal of defendants from report of local Master at Ottawa. The action was brought by plaintiffs to recover $18,669.50, alleged to be due by defendants, for electric lighting of the City of Ottawa under a contract. The controversy was as to the legal relationship of the parties in consequence of the destruction of the works of plaintiffs, in common with a large part of the City of Ottawa, by the great fire in April, 1900. The Chancellor read the contract as meaning that if no light was furnished from unforseen accident there was to be no pay and no penalty during such time; when light began to be furnished pay began pro tanto, the company all the while being in no default.

Mr. George Foss is superintending the installation of the municipal electric plant at Windsor Mills, Que.

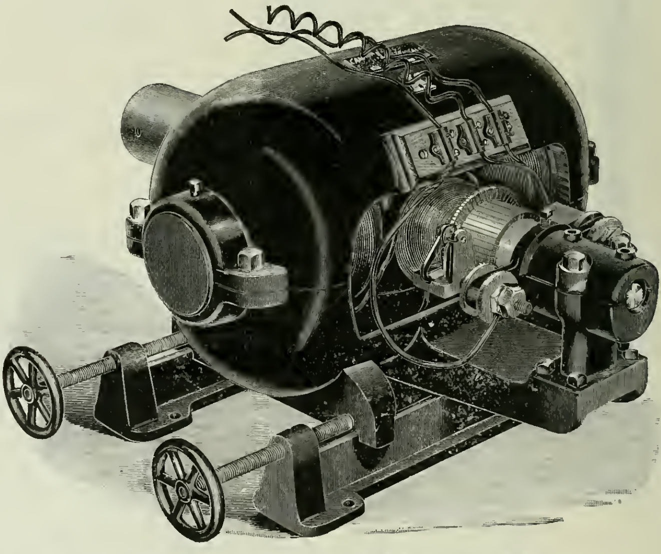
It is the intention of the Engineers' Club of Toronto to make a two days' visit to Peterboro this summer, to inspect the hydraulic lift lock now nearing completion and other engineering features in the vicinity of Peterboro. Mr. J. A. Culverwell has promised to provide a trip by steamer on the back waters, and it is probable that a formal reception will be tendered the society by the Council. The date of the visit has not yet been fixed.

Sole Makers of the . .
SYRACUSE BABBITT METALS
Which are the best for all machinery bearings, also wire and bar solder. We purchase scrap copper wire and brass scrap.
Syracuse Smelting Works
MONTREAL, P. Q.
Head Office American Works, 94 Gold St., New York City.

THE "TRITON" —MARINE— Gasoline Engine
Simplest, Safest and Most Reliable.
Hamilton Motor Works
Hamilton, Canada.
258 Catharine Street North.
"Engines in successful operation from Halifax to Vancouver."

CHASE--SHAWMUT COMPANY
390 Atlantic Avenue, BOSTON, MASS.
MANUFACTURERS OF . . . . . . Electrical Specialties
RELIABLE DURABLE EFFICIENT ECONOMICAL
"Shawmut" Tested Fuse Wire and Links
"Shawmut" Enclosed Indicating Fuses
"Shawmut" Junction and Outlet Boxes
"Shawmut" Flexible Rail Bonds
"Shawmut" and "Monadnock" Switches
"Chase" Nipples and Flexible Conduit Couplings
"Boston" Cable Hangers
"Cushing" Theatre Switchboards
"Cushing" Stage Lighting Appliances
Switchboards and Panel Boards
Electrical Repairing

REGISTERED 1901.



KING EDWARD DYNAMO AND MOTOR
BUILT ONLY BY THE.... CONSOLIDATED ELECTRIC CO., LIMITED.
9 and 11 Court Street, TORONTO.

Cold Water Paint for Outside and Inside Use.
Weather Proof.
Fire Proof.
Standard ; Matchless Quality.
LYTHITE TRADE MARK
WHITE AND COLORS.
COLOR CARDS AND PARTICULARS FROM
Durable.
W. A. FLEMING & CO.,
771 Craig st., Montreal.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. JULY, 1903 No. 7.

OTTAWA ELECTRIC COMPANY.

Then annual meeting of the Ottawa Electric Company was held a fortnight ago. The report submitted showed that the gross revenue from all sources for the year was $217,386.83, and the expenses of operating and maintenance $118,890.44, leaving a gross profit for the year of $98,496.39. The gross revenue as compared with the previous year decreased $10,248,00 due to a reduction of 20 per cent. in the charges for lighting which came into effect on November 1st, 1902, and a further reduction of 20 per cent. which took effect February 1st, last. The sum of $58,541.95 was expended upon capital account during the year for the new power house switch-board, extension of pole lines and circuits, etc.

The statistical statement contained the following information : The increase in the number of customers for the year was 321, the figures standing : 1902, 5,820 ; 1903, 6,141. In the number of incandescent lights installed there was an increase of 9,926, the figures reading : 1902, 104,407; 1903, 114,133. In 1903 there were 887 arc lamps as against 752 for the previous year, an increase of 135. Heaters showed an increase of six, there being 30 in 1903 as against 24 in 1902. Motors showed a similar increase in numbers, there being 163 in 1903 as against 157 in 1902. In the last nine years there has been an increase of 3,421 in the number of the company's customers, in fact the number has been doubled.

Directors were elected, and at a subsequent meeting of the directors the following officers were chosen : President, T. Ahearn ; Vice-President, F. P. Brompton.

The C. E. A. Convention Group at the Canada Foundry Company's. Works.

THE CANADIAN ELECTRIC LIGHT COMPANY.

The annual report of the Canadian Electric Light Company, of Quebec, Que., presented at the annual meeting in that city on June 23rd states that on the 1st of May, 1902, they had in operation 5,777 electric lamps, and, on the 30th of April, this year, they had 11,484, that is, 4,410 more than during the last year, which is equivalent to an increase of 62 per cent. On the 30th of April, 1902, they supplied 72 electric horsepowers, as motive power. Oh the 30th of April, this year, they supplied 276, which represents an increase of 362 per cent.

The company are now supplying power for the operation of the Levis County Electric Railway, the construction of which is largely due to the president, Mr. G. U. G. Holman.

The report further states that the company have laid a second cable across the river. It is placed far enough from the first cable that the two will not be exposed to the same risks and the same inconveniences. The new installation at Chaudiere Falls, including new turbines and dynamos, is expected to be completed in September.

For the twelve months ending April 30th, 1903, the earnings of the company were $35,459.54, an increase of $15,915.27. The new plant will increase the productive power by about 66 per cent.

The town council of Fort William, Ont., have appointed a committee to act with an engineer in ascertaining the cost of developing 2,000 horse power of electrical energy at Ecarte Rapids.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY
THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.

1ST VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

2ND VICE-PRESIDENT:
A. A. WRIGHT, M. P., President Electric Light & Power Co., Renfrew, Ont.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.
A. A WRIGHT, M. P, President Electric Light & Power Co., Renfrew, Ont.
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.
C. K. GREEN, Superintendent Hamilton, Grimsby and Beamsville Electric Railway, Hamilton, Ont
CHARLES B. HUNT, Manager London Electric Co., London, Ont.
J. A. KAMMERER, Director Cataract Power Co., Hamilton.
H. O. FISK, Superintendent Peterborough Light & Power Co., Peterborough, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON, - -	Toronto
Vice-President, CHAS. MOSELEY, -	Toronto.
Treasurer, A. M. WICKENS, - -	Toronto.
Registrar, J. G. BAIN, - - -	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN, - -	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER -	Baden, Ont.
Vice-President, H. E. TERRY,	Toronto, Ont.
Secretary, W INGLIS, - -	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont.
Conductor, J. STRUTHERS, -	Sarnia, Ont.
Door Keeper N. BEAN, -	Waterloo, Ont

The Canadian Electrical Association. The Thirteenth Annual Convention held in Toronto last month marked another distinct advance in the history of the Association which has made steady and substantial progress since its organization. Starting with a membership of about twenty-five it has grown to be a strong and influential organization with nearly four hundred members representing electrical interests in every part of Canada, with a fair sprinkling from the United States.

The recent convention brought together an attendance of nearly two hundred, and included members from such distant points as Halifax, the Northwest Territories, St. Louis and Cincinnati. A gratifying feature was the large and constant attendance of members at the business sessions, and their close attention to the papers and discussions. This may be taken as proof of a desire to profit by the information supplied at these meetings by experts and men of wide experience in the electrical field. The papers were of a very interesting and instructive character. The only cause of objection in this connection would seem to be the relatively small proportion of papers of late by Canadian authors. Canadians should come more prominently to the front in the preparation of papers for future conventions. There undoubtedly are a number of men identified with the electrical interests of Canada who have not yet been heard from, whose experience, if put on paper, would benefit the Association and the electrical fraternity at large. It is to be hoped the Committee on Papers for the present year may be able to discover some of these men and bring them to the front.

The Question Box, which of late has become so popular and valuable a feature of the National Electric Light Association of the United States, was introduced at the C. E. A. convention this year, and met with instant favor. Unfortunately but little time could be given to it, as the programme was practically completed before it occurred to some of the members to suggest the adoption of the idea. The Executive has been asked to appoint an editor for the Question Box and an appropriation has been made to cover the cost of the necessary correspondence. If every member will make a point of submitting one or more questions or answers during the year, a fund of information of the greatest value will be secured and made available for use. As time goes on other means will no doubt be found of increasing still further the benefits conferred by the Association upon its members.

The Local Committee received well merited praise for the carefull planned and executed programme of entertainment provided for the visitors. No hitch of any kind occurred, and so far as could be learned everybody had a good time.

The election to the Presidency of Mr. J. J. Wright, first President of the Association, who was prevented by serious illness from attending the convention, was a graceful recognition of that gentleman's unwavering interest in and valuable services to the Association from the days of its infancy until the present. With the loyal support of a capable Executive, the continued progress of the Association in numbers and usefulness may confidently be predicted, and a successful meeting in Hamilton next year anticipated.

Canadian Electrical Association

Proceedings of the Thirteenth Annual Convention

THE thirteenth annual Convention of the Canadian Electrical Association was held in the Assembly Hall of the King Edward Hotel, in the City of Toronto, Ontario, on Wednesday, Thursday and Friday, June 10th, 11th, and 12th, 1903.

At 11 o'clock a.m. on Wednesday the President, Mr. B. F. Reesor, of Lindsay, took the chair, and called the Convention to order.

The following persons were registered as being in attendance :

A

C. H. Abbott, St. John, N.B., R. E. T. Pringle Co.
J. G. Archibald, Woodstock, Ont., Corporation Lighting System.
J. J. Ashworth, Toronto, Canada Foundry Co.
Geo. Angus, Toronto, C. E. A. Official Stenographer.
K. T. Aitken, Toronto, C. G. E. Co.
Jas. Anderson, Windsor, Ont.

B

Frank G. Bolles, Cincinnati, Bullock Electric Mfg. Co.
J. A. Burns, Montreal, Munderloh & Co.
Wm. A. Bucke, Toronto, C. G. E. Co.
A. T. Beecroft, Corporation of Barrie, Ont.
F. Jno. Bell, Montreal, C. G. E. Co.
R. G. Black, Toronto Electric Light Co.
A. E. Brock, Toronto, National Electric Co., Ltd.
H. D. Bayne, Montreal, Westinghouse Co.
C. W. Bongard, Manufacturers Agent, Toronto.
J. E. Bilger, Toronto, Berlin Gas Co.
Jas. Bannon. Toronto, Chief Engineer City Hall.
E. B. Biggar, Toronto.
Wm. B. Boyd, Sydney, C. B., Dominion Iron & Steel Co.
W. A. Boys, Barrie, Ont.
J. H. Bennett, Municipal Electric Plant, Barrie.
W. M. Beall, Toronto, Consolidated Electric Co.
L. J. Belnop, Montreal, Bullock Electric Mfg. Co.
Henry P. Beaupre, Montreal, Westinghouse Co.
W. H. Breithaupt, Berlin, Ont.
J. F. Birchard, Detroit, Wing's Graphite Co.

C

J. W. Campbell, Toronto, C. G. E. Co.
V. B. Coleman, Port Hope Electric Light & Power Co.
Alfred Collyer, Montreal, Bullock Electric Co.
Geo. A. Childs, Montreal, American Steel & Wire Co.
R. E. Campbell, Toronto Metaphone Co.
P. S. Coate, Chatham, Ont., Gas Co.
C. E. A. Carr, Manager Elec. Street Railway Co., London, Ont.

D

A. A. Dion, Superintendent Ottawa Electric Co.
W. F. Dean, Toronto, C. G. E. Co.
Alfred Demers, St. Cesaire, Que., C. G. E. Co.
J. M. Dobbie, of A. G. Dobbie & Co., Brockville.
A. T. Duncan, St. Catharines, Manager Lincoln Electric Light & Power Co.
J. M. Deagle, Cataract, Ont.
J. Deagle, Jr., " "
L. Denis, Quebec, Jacques-Cartier Electric Co.
Hy. Stansfield Dodd, United Electric Co., Toronto.
F. F. Dryden, Toronto, Westinghouse Co.
Cecil Doutre, Montreal, John Forman Co.

E

H. O. Edwards, Toronto, C. G. E. Co.
A. Esling, Toronto, R. E. T. Pringle Co.
Ed. A. Evans, Manager Quebec Railway, Light & Power Co.
W. D. Earngey, Toronto, Secretary Hooper Magnetic Electric Brake Co.
E. S. Edmondson, President Oshawa Electric Light Co.
H. C. Ebert, Pittsburg, Pa., Westinghouse Co.

F

H. O. Fisk, Peterboro Light & Power Co.
Chas. L. Farrer, Lakefield, Ont., Electric Light Co.
T. C. Frenyear, Buffalo, Westinghouse Co.
J. W. Farley, Pittsburg, " "
C. E. Fortier, Toronto.

G

John Galt, C. E., Toronto.
G. Groves, Corporation of Parry Sound.
P. G. Gossler, Gen. Supt. Montreal Light, Heat & Power Co,
J. C. Grant, Toronto, B. F. Sturtevant Co,

H

Ormond Higman, Ottawa, Chief Electrical Inspection Dept.
Chas. B. Hunt, London, Ont., Electric Co.
A. T. Hicks, Trenton Electric & Water Co.
P. H. Hover, New York Insulated Wire Co., N. Y.
C. W. Henderson, Montreal, Westinghouse Electric Co.
Gordon J. Henderson, Supt. Hamilton Electric Light & Cataract Power Co.
J. Herbert Hall, Toronto, Richmondt Conduit & Mfg. Co., Ltd.
Thos. Hilliard, Ottawa, C. G. E. Co.
J. G. Howorth, Toronto, Manager Consolidated Electric Co., Ltd.
J. R. Hooper, Toronto, Travelling Representative Canadian Electrical News.
Geo. F Haworth, Toronto, Sadler & Haworth.
R. B. Hamilton, St. Catharines, Packard Electric Co., Ltd.
Chas. H. Hines, A. I. E. E., Montreal, Electrical Engineer Canadian Pacific Railway Co.
G. U. G. Holman, Quebec, Gen. Mgr. Canadian Electric Light Co., President Levis County Railway.
G. B. Henderson, Toronto, Manager Henderson Roller Bearing Co.
R. J. Henderson, Toronto, Henderson Roller Bearing Co.

I

E. Irving, Toronto, The Sunbeam Incandescent Lamp Co.

J

E. J. Jenking, Toronto, C. G. E. Co.
Jas. Johnston, Ottawa, Public Works Dept.
W. A. Johnson, Toronto, Manager The United Electric Co., Ltd.
J. K. Johnstone, Toronto, Government Inspector Electric Light.
H. Jecks, Toronto, C. G. E. Co.

K

H. B. Kirkland, Chelsea, Mass., American Circular Loom Co., Boston.
Jos. Knox, Manager Stayner Electric Light Co.
Stephen T. Kelly, Barrie Electric Light Co.
J. A. Kammerer, Toronto, J. A. Kammerer & Co.
Jas. Kynoch, Toronto, C. G. E. Co.
E. H. Keating, Manager Toronto Street Railway.

L

J. M. Leamy, Buffalo, Westinghouse Co.
H. A. Livingston, Toronto.
A. B. Lambe, Jr., Toronto, C. G. E. Co.
F. H. Leonard, Jr., Montreal, Canadian Bullock Electric Mfg. Co., Ltd.
J. D. Lachapelle, Montreal, Electrical Engineer Richelieu Navigation Co.
F. Lyonde, Toronto.
Robt. T. Lozier, Cincinnati, Gen. Manager Bullock Co.
J. D. Lawson, St. Louis, Mo., Dean of the Missouri Law School.

M

C. H. Mortimer, Toronto, Secretary-Treasurer Canadian Electrical Association.
H. A. Moore, Toronto, Canadian Bullock Electric Co.
L. D. W. Magie, Peterboro, C. G. E. Co.
R. T. Macken, Toronto, Engineer C. G. E. Co.
F. W. Martin, St. Catharines, The Martin Electric Supply Co.
A. P. Manning, New York, Cutler Hammer Mfg. Co.
G. C. Mooring, Toronto, Chief Engineer Methodist Book Room.
J. W. Moyes, Manager Metropolitan Electric Railway, Toronto.
W. R. J. Macpherson, Peterboro, Ont.
Geo. F. Madden, Toronto, C. G. E. Co.
W. H. Meldrum, Peterboro, Otonabee Power Co.

Mc

Wm. McKay, Toronto, Robb Engineering Co.
B. G. McBurney, Toronto, C. G. E. Co.
F. E. McCollum, Toronto, C. G. E. Co.
Wm. McCaffrey, Toronto, C. G. E. Co.
J. K. McDonough, Toronto, C. G. E. Co.
W. McLeish, Toronto, Monetary Times.
J. M. McLennan, Lindsay, President Light, Heat & Power Co.

N

F. Nicholls, Jr., Toronto.
G. B. Nicholson, Toronto, C. G. E. Co.
H. G. Nicholls, Toronto, C. G. E. Co.

O

Dr. R. B. Owens, Montreal, Prof. Electrical Engineering, McGill University.
Geo. H. Olney, Montreal, Eugene F. Phillips Electrical Works,

P

J. W. Purcell, Walkerville, Chief Electrician Hiram Walker & Sons.
J. W. Pilcher, Halifax, N. S., C. G. E. Co.
E. B. Price, Toronto, C. G. E. Co.
Rod. J. Parke, Toronto, Consulting Electrical Engineer.
Edwin Pope, Quebec, G. N. W. Telegraph Co.
E. G. Patterson, Peterboro, C. G. E. Co.
Louis W. Pratt, Brantford Electric & Operating Co.
G. A. Paterson, Brandon, Man., Electric Light Co.

R

B. F. Reesor, Lindsay, Manager Electric Light, Heat & Power Co.
Jos. Rogers, Toronto, Rogers Electric Co.
C. E. Reid, Toronto, Rogers Electric Co.
L. H. Reesor, Corporation of St. Mary's, Ont.
F. Rose, Toronto, C. G. E. Go.
Geo. C. Rough, Montreal, The Packard Electric Co.
Alex. Reid, Strathroy, Ont., E. L. & W. W.
R. J. Russell, St. Louis, Mo., Wagner Electric Mfg. Co.
A. C. Read, Levis, Que., Canadian Electric Light Co.
W. G. Richards, Chatham, Ont., Gas Co.
W. H. Reynolds, Montreal.

S

C. C. Starr, Halifax, John Starr, Son & Co.
R. M. Saxby, C. E., Manager Bowmanville Electric Light Co.
A. Sangster, Sherbrooke, Que., Manager Power, Light & Heat Co.
A. B. Smith, Toronto, Superintendent G. N. W. Telegraph Co.
W. F. Simmons, Kingston Light, Heat & Power Co.
A. W. Smith, Toronto.
Alex. H. Skene, Bracebridge, Ont,
E. A. Smith, Toronto, Consolidated Electric Co.
Chas. F. Scott, Pittsburg, Pa., President American Institute of Electrical Engineers.
Irving Smith, Montreal, The R. E. T. Pringle Co.
R. A. Stinson, Toronto, C. G. E. Co.
Edward Sise, Montreal, The Wire & Cable Co.
D. M. Stewart, Montreal, General Manager The Sovereign Bank of Canada.
J. E. Skidmore, Cobourg Water & Electric Co.
Warren Y. Soper, Ottawa, Ahearn & Soper Ltd.
Thos. Stewart, Lindsay, Light, Heat & Power Co.
Alex. Smith, Toronto Street Railway Co.
J. E. Stephenson, Montreal, J. C. McLaren Co.
J. Sangster, St. Catharines, Ont., Superintendent Power House Cataract Power Co.
R. J. Sanderson, Orillia, Ont., Municipal Light & Power Plant.
E. T. Sifton, London Electrical Construction Co.
L. Sangity, Hamilton, Superintendent Power House Cataract Light & Power Traction Co.
Alderman Starr, Acting-Mayor, Representing Corporation of Toronto.
A. Storer, Toronto, Chief Electrical Engineer King Edward Hotel.

T

Fred Thomson, Montreal, F. Thomson & Co.
J. P. Thomson, Montreal, E. F. Phillips Electrical Works Ltd.
G. S. Thomson, New York City, The Adams-Bagnall Electric Co.
Max Toltz, Montreal, Consulting Electrician C. P. R. Co.
J. Fredrick Thorne, Pittsburg, Pa., Westinghouse Co.
Clarence Thomson, Montreal, F. Thomson & Co.

W

A. A. Wright, M. P., Renfrew. President Electric Light & Power Co.
G. M. Wright, Montreal, R. E. T. Pringle Co.
A. E. Wilson, Toronto, C. G. E. Co.
Chas. Wilkinson, Brockville Light & Power Department.
W. H. Wiggs, Quebec City, Mechanics Supply Co.
Wm. Wilds, Sarnia Street Railway Co.
Wm. Williams, Manager Sarnia Gas & Electric Light Co.
J. A. Whyte, Toronto, Assistant Inspector Gas & Electric Light.
Geo. W. Watts, Toronto, Assistant-Manager C. G. E. Co.
F. C. Whatmough, Stratford, Ont., Electrical Contractor.
R. R. Wiley, St. Catharines, Packard Electric Co.
W. Warren, Toronto, C. G. E. Co.
C. W. Watson, Orangeville, Ont.
W. D. Wilgar, Toronto, C. G. E. Co,
G. E. Woodhouse, Toronto Metaphone Co.
E. Ward Wilkins, Philadelphia, Pa., Partick, Carter & Wilkins.
C. D. Warren, Toronto, President Metropolitan Electric Railway.
Arthur Warren, New York, Westinghouse Co.
A. M. Wickens, Toronto, Inspector Canadian Casualty & Boiler Insurance Co.
Alderman Ward, Toronto.

Y

John Yule, Manager Guelph Light & Power Co.

The President called upon Ald. Starr, who, in the absence of His Worship Mayor Urquhart at Ottawa, was acting Mayor, and Ald. Ward, Chairman of the Civic Reception Committee, to address the Convention.

Ald. Starr : Mr. President and Gentlemen: On behalf of the Corporation of the City of Toronto I desire to extend a very hearty welcome to the Canadian Electrical Association. I do not suppose that we have had meeting within the borders of our city a more important association than the one which is now before me. I notice by your programme that the citizens of Toronto ought to be deeply interested in some of your deliberations. I see one of your members is to read a paper on "Long Distance Transmission." The City of Toronto is struggling, perhaps from another standpoint, with the same question of long distance transmission. We think if we can get power cheap enough from Niagara Falls we can make out of this City of Toronto, beautiful as it is now, a great industrial manufacturing centre, because of cheap power that will come to us. It may be that we cannot follow the technicalities of a scientific paper on the question, but we can follow the economical problem. I would suggest that you add to that paper another paper entitled : "How the City of Toronto can get cheap power in competition with the companies that have already got the control of the power over at Niagara Falls." If any citizen or any one of your members could help the City of Toronto out on such a problem as that I am sure the City of Toronto would vote not only to give him the freedom of the City of Toronto, but I think we could strain the point and give the freedom of the city to all the members of the Association. (Laughter). Unfortunately, however, I fancy that will lie beyond your ken, and if I would make a guess I would say that probably some of you might be on the other side of the fence on that proposition. We will struggle with it, however, and if we are right we may believe it will come out alright in the long run. I congratulate you, Sir, on the nature of your programme. As far as I can gather from it, it seems to me you have introduced what is called the Question Box, and I know of no greater or better means of information both for discussion and for the acquirement of knowledge than the Question Box. I have had occasion to use it in more ways than one during an experience with conventions, and I find it a most valuable aid to the ordinary humble follower of the usual convention. I do not wish, however, to take up any further time. We think to-day we welcome you to the best hotel on the Continent ; we think to-day we welcome you to the most beautiful city on the Continent ; we think it is clean, if I may say, physically, and we think it is clean morally in a fair comparison with any other city to which we apply it. I have been in my limited experience as far as Chicago, any way, and I think we will compare favorably with the City of Chicago in cleanliness in every way, that is without desiring to reflect at all on Chicago; it is only a comparison. But, feel free to look around for yourselves and see what we have. I am sure that some of you will think that you ought to return and live with us, for we will be able to help you in the day to come. (Applause).

Ald. Ward : Mr. President and Members of the Canadian Electrical Association : I had no idea I was going to be called upon to speak after acting Mayor Starr ; I thought he had covered the ground. However, as Chairman of the Civic Reception Committee, I wish to add a few words of welcome to your delegates while in the city and I hope that you will have a pleasant time while amongst us and carry away pleasant recollections of your visit to the city of Toronto. I hope, Sir, that your deliberations while in session will be of material benefit to your wide-growing institution. I recognize the Canadian Electrical Association as one of the most important in this country,and I am sure that much good will be wrought from your work during the next few days. I hope while in the city you will have an opportunity of visiting our magnificent city hall and viewing our other public buildings. Your local Entertainment Committee have provided a very nice social programme for your entertainment, and I am sure that you will go away with pleasant recollections of your visit. I thank you for calling upon me. (Applause.)

The President : Mr. Dion, of Ottawa, will reply to the address of welcome.

Mr. Dion : Mr. Chairman, I am called on very short notice to reply to the eloquent addresses we have just heard. I do not know that I can do justice to the subject, but I feel that it will be sufficient to express to the acting Mayor and Ald. Ward our warm thanks for their kindness in coming here this morning, for the very nice things they have said about us, and for tendering us the hospitality of this beautiful city. We feel very grateful to them and the citizens of Toronto. We are glad to meet in this beautiful and interesting city of Toronto and we know that our stay here will be quite as profitable and pleasant as I am sure they wish it to be. With regard to the suggestion thrown out by the Acting Mayor that we should find means of introducing into Toronto cheap power in competition with the existing companies, I have to say, speaking for myself, that I am not in that business. Other members may say what they think about it. (Applause.)

The President then delivered the annual address, as follows :

PRESIDENT'S ADDRESS.

To the Members of the Canadian Electrical Association :

GENTLEMEN,—It affords me a great deal of pleasure to extend to you all a most hearty greeting at this the opening of the thirteenth convention of the Association in the City of Toronto. I must congratulate you that our meeting this year is under such favorable circumstances ; this City is centrally situated and of easy access from every direction. The officers and executive of the Association have been looking forward to a large attendance and a most profitable meeting.

There have been prepared for us by members of the Association and others a number of valuable papers which will be read in due course, and I bespeak for them your most careful consideration and trust you will follow the reading of them with a free and thorough discussion, so that the salient points in each may be brought out or criticized, and in this way the members present may get the benefit of the knowledge imparted to the fullest degree.

This year a new feature, at least to this Association, has been inaugurated in the establishing of a question drawer,from which I am confident, if properly followed up, much benefit will accrue.

The National Electric Light Association has been working along these lines for some time with unqualified success. In this connection I would suggest that when electing our officers for the ensuing year a "Question Box Editor" be named whose special duty it will be to look after this matter and receive from members of this Association and others, questions that may be pertinent to the interests of light and power companies and those interested in electricity generally.

During the year that is past the question of long distance power transmission has engrossed the minds of capitalists to a greater degree perhaps than at any previous period in the history of this country. Rapid strides have been made in development in this direction and at the present time some very extensive plants are contemplated and under construction, notably around the Niagara Peninsula, and when completed Canada can boast of having some of the largest and best equipped electrical installations in the world.

The successful transmission of wireless messages across the ocean has also been accomplished since our last meeting. Truly electricity has passed its "infancy" stage; let the use of electricity be suspended for one day, yes even for one hour, and our whole commercial,if not our domestic system would be paralyzed.

I trust you are not losing sight of the fact that the tide of municipal ownership is in full flow ; while at this juncture I have not the time, nor the inclination, to discuss the merits or demerits of the movement. I may say, however, in passing that frequently we learn of individuals and municipal councils with whom it has become, to say the least, considerable of a craze, or in other words a case of "municipalities gone mad," but during all this turmoil of unrest we must not forget that vested interests are at stake and must be looked after. Millions of money have been invested in this country by individuals and companies in lighting and power development, sanctioned, and in many intances induced, by the very municipal corporationsthat are now clamoring after or looking with longing and covetous eyes at a business that has been carried from an experimental stage until it has become to all appearances a factor of considerable importance in our every day commercial life.

While the interests above referred to have been most faithfully and I may be permitted to say, most successfully, looked after by your committee appointed for that purpose by this Association, at the same time we feel that the support (financial and otherwise) due this committee by the rank and file of those most vitally interested in the matter has been most lamentably neglected. Why any man or company of men who may have their money invested in lighting or power plants cannot see their way clear to become members of the Canadian Electrical Association is beyond my comprehension. The lessons and experience of the past few years since municipal corporations have been going into the commercial lighting business, should be an incentive for everybody interested in electricity to join this Association and bear their quota of the burden, at least in proportion to the benefit that must necessarily result from the efforts the Association exerts in their behalf. I am glad to say the membership during the past year has been steadily increasing, some thirty members having been added to the roll.

The Association generally is in a flourishing condition ; a detailed report of the finances will be brought down by your Secretary.

I beg to acknowledge with thanks a most pressing and cordial invitation from The National Electric Light Association of the United States to the officers of this Association to attend their annual convention which was held this year in the city of Chicago a few weeks ago. I am pleased to say several members availed themselves of the pleasure of accepting the invitation and attended.

The Local Committee, as you see, have been most indefatigable in making very favorable arrangements for your personal comfort while attending the convention and also in providing social entertainments for you between the sessions. I expect every member to attend regularly and promptly at the sessions and trust the thirteenth convention, and the first held at "The King Edward," will be one of the most successful in the history of the Association.

I now declare the convention duly opened.

B. F. REESOR, President.

The President called upon the Secretary to read the minutes of the last annual meeting.

On motion of Mr. Yule, seconded by Mr. Smith, the reading of the minutes of the last annual meeting was dispensed with, and they were taken as read.

The President called for the report of the Secretary-Treasurer, Mr. C. H. Mortimer, which was as follows:

SECRETARY TREASURER'S REPORT.

The Executive Committee has held three meetings since last convention, viz : On September 12th, 1902, February 13th, 1903, and immediately preceding the opening of this convention. On September 12th two active members were elected, accounts in connection with the Quebec convention passed, and the President and Secretary authorized to deal with members in arrears for fees.

On February 13th one active member was elected, and the resignation of one member received; the dates were chosen for the present convention, and the Secretary instructed to apply to the railways for reduced rates. It was resolved that the President and Vice-Presidents should compose the Committee on Papers, with power to add to their number. Messrs. Gossler, Dion and J. J. Wright were appointed a committee to award prizes for papers of superior merit, under the terms of a resolution passed at the previous meeting of the Executive relative to the disposal of the fund donated by the Canadian General Electric Company for this object.

At the meeting this morning 25 persons were elected to membership. The membership now stands at 344, as compared with 306 at date of last report, an increase during the year of 38.

The Question Box, which is a prominent feature of our programme this year, should interest central station men, a larger number of whom should be connected with the Association and should attend the conventions. This feature is proving a great success in the National Electric Light Association, upwards of 250 questions appearing this year on their circular.

I have thought that it might be possible to organize in Toronto, Montreal, Ottawa, and perhaps other centres, local branches or clubs composed of members of the Association, which would hold monthly meetings of a social character during the autumn and winter, at some of which perhaps brief papers on electrical subjects might be presented, to be followed by discussions. These papers might be circulated among and discussed by the various clubs, and afterwards printed and distributed to the members. In this way closer acquaintanceship would be promoted among the members, at least in the cities, and active interest in the Association stimulated. I throw out the suggestion in the hope that if it meets with approval, means may be found of putting it in practical operation.

It is the opinion of some of the members, including some members of the Executive, that the important work hitherto performed by the Legislation Committee might now be carried on to better advantage by a separate organization outside of the Association. The question will probably come up for consideration at this convention.

It will be a matter of deep regret to the members that Mr. J. J. Wright, an ex-President, and one of the most useful and highly respected members of this Association, has been laid aside for several months by serious illness, and is not yet sufficiently recovered to be able to participate in this convention. The sympathy of the members will also be extended to our esteemed President, Mr. Reesor, who has been bereaved of his wife in the interval since last convention.

As will be seen by the accompanying statement, our financial position is somewhat improved, the balance in hand being $404.17, as compared with $327.11 at date of last report. This sum is exclusive of donation of $500 by the Canadian General Electric Company, which is not available for the general purposes of the Association.

TREASURER'S REPORT FOR YEAR ENDING MAY 31st, 1903.

RECEIPTS.

Cash in Bank June 1st, 1902	$792 28	
Cash in hand June 1st, 1902	34 83	
160 Active Members' Fees	480 00	
31 Associate Members' Fees	89 00	
1 Student's Fee	1 00	
Transcribing Mr. Evans' Paper	1 00	
		$1398 11

DISBURSEMENTS.

Badges 1902 Convention	9 00	
Postage "	28 71	
Exchange on Cheques	5 70	
Express Charges	5 66	
Telegrams	3 05	
Stationery	5 04	
Grant to Secretary	125 00	
Stenographer	60 00	
Printing (including 400 Copies of Proceedings)	168 50	
Travelling Expenses to Quebec to make arrangements re Convention—P. G. Gossler	13 67	
K. B. Thornton	13 68	
A. A. Dion	17 85	
Engravings to Illustrate Convention Papers	5 08	
P. G. Gossler—Expenses incurred while President	25 00	
Acton Burrows—Refund of amount paid by him to official stenographer for transcript of Mr. Lambe's Paper	3 00	
Cash on Hand	28 59	
Cash in Bank	880 58	
		$1398 11

C. H. MORTIMER, Secretary-Treasurer.

Mr. Smith moved, seconded by Mr. Higman, that the report of the Secretary-Treasurer be received, which was carried.

The President appointed as auditors Messrs. Hunt (London), and Fisk (Peterboro).

The Secretary read letters from the following: Mr. W. A. Martin, Secretary of The Toronto Electric Light Company, extending to the members of the Association a cordial invitation to visit their stations and showrooms; from the Mayor of St. Louis and the Business Men's League, extending invitations to the C. E. A. to hold their next convention in the city of St. Louis, during the Louisiana Purchase Exposition, as it was the intention to hold an International Electrical Convention at that time.

The Secretary stated that Prof. Owens would perhaps be able to give the members some further information with regard to the matter.

Prof. Owens: The authorities of the St. Louis Exposition are organizing an International Electrical Congress to be held in the first week of September in 1904; the American Institute of Electrical Engineers, the National Electric Light Association of the United States, and other societies will participate, and the management of the Exposition is very anxious that the Canadian Electrical Association will also participate in this International Electrical Congress. It is with great pleasure I extend, on behalf of the exposition authorities, this invitation to the Canadian Association.

Mr. Higman: I would move, seconded by Mr. Smith, a vote of thanks to the authorities who have extended this invitation to our Association, and I trust that the Association will find it in their power to cooperate with the other institutes in this International Congress at St. Louis. I had the privilege of being sent to the International Congress at Chicago in 1893 by the Canadian Government, and I can speak with some authority as to the great good that the electrical world in general derived from the deliberations of that Congress. The absolute units as we have them to-day were adopted at that Congress, and legislation followed all over the world making them legal, so that we find to-day the nomenclature and the value the same in all countries. It is hardly possible to over-estimate the value of this to electrical engineering. I trust that at the coming International Congress at St. Louis efforts will be made to have a similar successful congress and that this association will assist in forwarding the movement.

The President put the motion, which was carried unanimously.

The President called for reports of committees.

Mr. Yule presented the report of the Committee on Legislation, as follows:

REPORT OF COMMITTEE ON LEGISLATION.

To the Canadian Electrical Association:

GENTLEMEN,—Your Committee on Legislation beg to report that their first meeting was held in Toronto on March 4th last. It was then quite evident that a strong attempt was to be made in the Legislature to repeal the Conmee amendments to the Municipal Act. The situation was fully discussed and the advisability of the C. E. A. continuing to assume responsibility of caring to the companies' interests was carefully considered. At this meeting it was decided to send notices to all Lighting Companies to attend a meeting in Toronto on the 12th of March. At this meeting about 25 companies were represented out of a total of about 140 companies and individuals operating plants in the Province of Ontario. The situation was laid before those present and a resolution passed to form a separate organization consisting of companies' representatives. Mr. Reesor was elected President and the Executive Committee appointed largely consisted of the members of your Legislative Committee. At the next meeting of the Committee it was felt for various reasons that need not be gone into in this report, that it would be for the best interests of all concerned to continue the old organization for this year. Arrangements for defence were at once made and a plan of campaign agreed on. Your Chairman, although not directly interested, remained in office and gave his services to the work in hand. Mr. Mortimer also agreed to continue as Secretary for a limited time.

Mr. Downey, member for South Wellington, introduced a bill for the total repeal of the Conmee amendments and at once commenced a strong and vigorous canvas in the House to secure his Bill being passed. This being the first session of a new Legislature, there is a large contingent of new and active members who are not fully informed on the merits of the question at issue. In a matter of this kind a detail of the work done by your Council and Committee cannot be gone into, but suffice it to say that every fair and reasonable effort was put forth to prevent the passing of Mr. Downey's Bill. We are pleased to be able to report that the Legislature after full and free discussion in the House and in Committee again affirmed the general principles of Mr. Conmee's amendments as being fair and just to the companies and municipalities, in the face of a great deal of misrepresentation and ignorance on the question.

Your Committee think that it may now be assumed that the underlying principles of the Conmee Bill are considered and admitted to be a reasonable protection to those who were induced to invest capital in and have developed the lighting business to its present proportions. The future danger is that amendments to the Act will be made, and unless carefully watched these amendments may seriously jeopardize the value of your properties. Your Committee desire to say that the amendment most discussed is a clause that will compel companies to sell, or to put it another way, will give municipalities the right to expropriate. Your committee consider it will be advisable for this convention to discuss whether or not the C. E. A. should continue to assume the responsibility of looking after the interests of the companies. We state very reluctantly that in our opinion the financial support accorded the Legislative Committee by the companies falls short of what it ought to be. In a vigorous attack such as was made on the companies during the last few weeks there is no time, or in fact inclination, to stop and consider the financial situation. We felt that large interests were entrusted to us and no effort was spared to defeat such an unjust proposal; the result is that we are considerably short of funds to meet our accounts, and trust that those who are receiving the benefit of our labors will put sufficient funds into the hands of our successors in office to pay all liabilities.

The following are the names of the companies who have contributed to the expense fund of the Legislative Committee:

Toronto Electric Light Co.; Gananoque Electric Light & Water Supply Co.; W. C. Harrison, Norwood; Smith's Falls Electric Power Co.; Welland Electric Light Co.; R. A. Corbett, Port Hope; W. Moore & Sons, Meaford; Ottawa Electric Co.; Knight Bros. Co., Burk's Falls; Galt Gas Light Co.; Guelph Light & Power Co.; Wingham Electric Light Co.; Brantford Electric & Operating Co.; Renfrew Electric Co.; Hamilton & Prout, Forest; Tremaine & Snell, Exeter; Henry Cooke, Hensall; Petrolea Electric Light, Heat & Power Co.; Seaforth Electric Light, Heat & Power Co.; Listowel Gas & Electric Light Co.; St. Thomas Gas Co.; Merrickville Electric Light & Power Co.; Ingersoll Electric Power & Light Co.; Joseph Knox, Stayner; W. H. Birchard, Aurora; Simon Plewes, Creemore; Frankford Electric Light Co.; Vankleek Hill Electric Light Co.; Stormont Electric Light & Power Co., Cornwall; Napanee Water & Electric Light Co.; Light, Heat & Power Co., Lindsay; Cobourg Water & Electric Co.; Peterborough Light & Power Co.; Lakefield Electric Co.; H. W. Foulds & Co., Hastings; Bowmanville Electric Light Co.; Cardinal Electric Light Co.; James Munroe, Embro; Herhert Webster, Norwich; Tilsonburg Electric Co.; Port Dover Electric Light Syndicate; Lincoln Electric Light & Power Co., St. Catharines; Sarnia Gas & Electric Light Co.; Alvinston Electric Light Co.; H. C. Baird & Sons, Parkhill; B. A. Gordon, Glencoe; Stratford Gas Co.; People's Electric Co., Windsor; Kingsville Electric Light Co.; Ridgetown Electric Co.; Pembroke Electric Light Co.; Pakenham Electric Light Co.; John Bourke, North Bay; Carleton Place Electric Light Co.; Arnprior Electric Light & Power Co.: Sturgeon Falls Electric Light & Power Co.; Waterloo Electric Light & Power Co.; Berlin Gas Co.; Jacob Morley, New Hamburg; Bearman & Co., Chesley; Thomas Andrews, Thornbury; H. Gruetzner, Hanover; Teeswater Light & Power Co.; Walter Stewart & Son, Lucknow; Crawford & McIntyre, Durham; Hutton Electric Co., Brampton; Georgetown Electric Light & Power Co.; Clinton Electric Light Co.; Mattawa Electric Co.; Leamington Electric Light Co.; London Electric Co.

JOHN YULE, Chairman.

This report, on the suggestion of Mr. Yule, was left over for discussion, to be taken up by an executive meeting of the Association consisting of only active members, and the President appointed Thursday morning at 9 o'clock for this purpose.

Mr. Higman : Perhaps I owe the Association an apology for having no report of the Arc Light Rating Committee. I have felt, and others of the committee have felt also, that owing to the transitional stage which arc lighting is in at present it would not be desirable to bring in a report recommending a standard. We have been moving from the old open arc light to the enclosed and the alternating, and now we have the Nernst lamp as a disturbing element, and it would be quite impossible to lay down hard and fast lines as to what shall constitute a standard. I might say that the original intention for moving in this matter insofar as the Department was concerned was to induce the companies to abandon the old method of making their contracts in terms of candle power. Frequently the Department was called upon to settle disputes between municipalities and electric lighting companies, and we found with contracts made in terms of candle power—a nominal 2000 candle power lamp for instance—it was quite impossible to do anything in the premises, and so we have been advocating, very successfully I think, the making of contracts in terms of energy delivered at the lamp. That would seem to be the general custom now, and so far as the department is concerned at any rate, we are quite satisfied to let the matter rest where it is. With the limited resources at the disposal of our Association, we could not attempt to take up a thorough investigation of this matter. The National Electric Light Association has been doing so and they have presented reports at their annual meetings of very great value, and which are available for our members. Even if we had the means we could not improve on the excellent work done. It will be for us to assimilate the information there prepared for us.

Mr. Hunt : I would like to state exactly what we did in a contract in London. The specifications were prepared by the city engineer. I think it gets over the difficulty of candle power entirely, that is, we have a lamp of a proper voltage and amperage, say 70 v. 6½ amp. to produce 450 watts or over. This is accepted by him as a 2000 candle power lamp and is also the standard adopted by the National Electric Light Association.

Mr. Dion : There was a committee of this Association appointed two years ago for the purpose of recommending a uniform system of accounting to the members of this Association. That committee was composed of Mr. Wright, of Renfrew, and Mr. Street, of Ottawa. They made a report at the meeting in Quebec, which for want of time was not discussed, the discussion was adjourned until the following day ; and then we found no time to dispose of it and it was left for this convention. Mr. Wright, of Renfrew, is not here as yet. Mr. Street is also prevented from coming, but he asked me to bring the matter up. He thought in fairness to the members of the committee who had devoted considerable time to investigation that the matter should be dealt with, and that their recommendation should either be set aside or adopted. The Secretary will get from his records the report presented last summer, and either at this session or some other session of this convention the matter could be disposed of. There was a recommendation contained in that report and I would like to submit it to the meeting when we get the papers before us.

The President : You have heard the explanation Mr. Dion gives. The Secretary will have these papers brought forward at another session.

There being no other business to bring before the meeting at this stage the Question Box was taken up and was conducted by Messrs. Dion and Hunt. The following were the questions sent out to members, together with the written replies submitted :

QUESTION BOX.

1. Is it advisable to "ground" secondaries at the transformer or in the building supplied ?

2. Should meters be tested in places or should they be returned to the station for that purpose ?

3. What systems are mostly used and commendable to check up lamp manufacturers' guarantees as to life, efficiency and c. p. ?

4. What has been the experience in operating single phase motors on lighting circuits and to what sizes of motors is such operation practically limited ?

5. Should 5 and 4 c. p. lamps be freely supplied to meter customers of electric light and renewals thereof made free ?

6. What is a proper annual charge for depreciation in waterpower plants, and how arrived at ?

7. What is the best practice to follow regarding the cutting and handling of wires in cities during fires ?

8. What is the best system for keeping records of poles and lines and regarding changes thereon ?

9 What is the best way for keeping track of transformers, their locations, sizes and the maximum active load on them ?

10. What precautions are advisable with free lamp renewals to prevent persons from selling them or using them in any other manner than that intended ?

11. Is it advisable to mark wires on poles so as to distinguish between feeders, mains and the different services on circuits, so a lineman may identify them without carrying a map of them in his head ?

12. What is the maintenance cost per kw. hour of the different types of Nernst lamps ?

13. In cases where machines of a different periodicity are in use, one machine 60 cycles and the other 125 cycles ; the 60 cycle machine used for the heavy loads aud the 125 cycle for the all night run ; what class of meter should be used which will register accurately within Government limitations on both frequencies. The Canadian Government require all meters to be within three per cent. either way of the average of ¼ and ¾ load. In cases like this do the Government base their figures on results obtained from tests on both frequencies, or is the meter simply tested on a machine of the same frequency as that stamped on its name-plate ?

14. I understand that there are several electrical companies manufacturing polyphase induction alternators. Are single phase machines ever built using the induction principle ? I have never seen any. I understand there is some fundamental reason for this. Is it regulation ?

15. What is the greatest distance ever talked over by telephone ?

16. What is the general opinion regardihg the use of barb wire above transmission lines as a lightning arrester ? Is the expense of installation and the cost of maintenance justified by the results obtained ? Does it give much trouble by breaking and causing shut-downs ?

17. With two high tension circuits on one pole what is the experience with the handling of repairs to one, the other being alive ? What is the highest voltage that can be so handled ?

18. Are four motor street car equipments justifiable in ordinary city service, the grades being practically negligible ?

19. What is the average power factor on plants of say 500-kw. and larger which are operating both arc and incandescent lighting and synchronous and induction motors ?

20. Would it be desirable for this Association to take up the question of preparing a publication giving the rates obtaining in this country for lighting, power, and heating service, together with an outline of the various plants ?

21. What are the factors that decide whether or not it is necessary to use bells on the ends of lead cable ? Where is the critical point, that is, above what voltage, power, length of cable, etc., etc., do they become necessary ?

22. For street lighting in small towns of 1,500 to 3,500 population, which is the better system to use ; the multiple alternating arc or the series alternating arc, and why ?

23. What size of wire is required to operate seventy-five 60-cyle, constant current, 7.5-ampere series alternating arc lamps on a circuit 18 miles long with 73 volts at arc ?

24. What method of grounding lightning arresters and transformer secondaries gives the best ground at the least cost ?

25. What is the ratio of transformer capacity to connected load for (a) residence lighting, and (b) business lighting ?

26. What should be the per cent. drop in voltage on a well-equipped alternating-current line between station and centre of distribution ?

27. What is the best way of testing meters on the customer's premises ?

28. What degree of accuracy at five per cent. of full load is it practically possible to maintain on wattmeters of the commutator type ?

29 What is the ratio of burnouts in a Nernst lamp between the ballasts and glowers of the lamp ?

30. What results, as compared with arc lights, has the Nernst lamp given for street lighting ?

31. Do Nernst lamps prove troublesome in their operation ?

32. As Nernst lamps consume much less current than other lamps in proportion to illumination, how is the customer charged for this service ?

33. Are Nernst lamps furnished by the lighting company, or do the customers, in the majority of cases, furnish their own lamps ?

34. Has anyone put Nernst lamps to a commercial use ?

35. Are Nernst lamps as efficient on watts consumed as claimed by manufacturers ?

36. What is the average life of Nernst lamp-glowers on good regulation, from practical experience ?

37. What globes have you found for interior arc lighting that are more decorative than the plain white or clear glass and, within reason as to cost and weight, while not absorbing more light than an opalescent globe ?

38. How do you figure depreciation ?

39. When meters are used by an electric-light plant, should there

be a minimum rate paid irrespective of the meter readings ; if so, what should the minimum rate be ?

40. What has been the experience of water-power plants with the maximum-demand flat rate, controlled by a Lacey controller, or similar device ?

41. Outside of cultivating a day load by supplying power, what is being done generally toward encouraging the use of summer current by water-power plants ?

42. Is there any recording watt meter designed to-day suitable for measuring both inductive and non-inductive loads from 2,000 volt circuits ?

ANSWERS TO QUESTIONS.

Sherbrooke Power, Light & Heat Company, Sherbrooke, Que.:

We have been asked to answer question No. 40, and herewith enclose our reply, which is based upon our experience so far. Systematic inspection, while not having been shown to be absolutely necessary so far, would seem to us to be very advisable, and a convenient method of testing controllers in place is desirable. Many theoretical and imaginary objections to the controller have been urged which have not yet materialized in practice.

40. An experience of about six months with the Lacey controller would indicate that it furnishes the best means so far put on the market to deal with flat rates.

As to its reliability in the matter of keeping in adjustment our limited experience will not allow us to state, as we have not made a systematic inspection of them yet.

That those set up so far have remained in adjustment would seem likely, as we have had no complaint of the limit of any customer having been cut down.

Common sense would, however, dictate that this instrument, the same as any other device for measuring current, should not be allowed to go for an indefinite time without inspection and test.

Inspection in September, November and January and probably in May would be sufficient.

Its makers would add to the popularity of the instrument by getting up a convenient and portable apparatus for verifying the controller without disturbing its setting or connection.

A testing box equipped with standard lamps or some other suitable load, with an indicating watt-meter or an ammeter and volt-meter attached, and a connecting device which would admit of the outfit being quickly attached to the circuit near the controller, would probably fill the bill.

In setting the controller it must be adjusted to the load contracted for at the extreme voltage to which the circuit is subjected otherwise the controller will trip when the voltage rises, without having more than the rated number of lamps in circuit.

Our average setting allows about 60 watts to a 16 C. P. lamp.

One effect of the use of the controller is to bring home to the average customer that there is a wide range in the efficiency of lamps.

Our contract is made in terms of 16 C. P. lamps, government standard, and the customer distributes his current to his own best possible advantage.

A. G. Sangster, Sherbrooke, One.:

1. At transformer.
2. In some cases in places, in others taken to the station.
5. They should not be supplied free. Nothing less than 8 C.P.
6. From 10 to 25 % according to fall of water.
7. The best and safest practice is to open the circuit in the fire district.
8. The map system, with location of poles, lines and transformers.
9. The card catalog, giving transformer location, maximum load, and when put up.
10. It is advisable both in station and on cross arms.
26. We have 8 circuits going out, distances being from one to three and a half miles. The drop is 2 to 3 per cent., which is about the correct loss.
39. Yes, have charged 75 cents per month irrespective of the meter reading ; this is to cover cost of transformers and connections.
40. The maximum demand rate by a Lacey controller suits quite a large class of customers, knowing the amount payable each month regardless of the hours burning. The contractor has the benefit of the load to put on a transformer—no meter readings and fewer inspections.
41. Cultivating the use of flat irons and fans.

O. Higman, Ottawa :

1. To ground secondaries at the transformer would seem to be the more preferable method. It would ensure all consumer's lines being protected ; whereas grounding in the building would often be found inconvenient and too often would be neglected altogether.

2. Government regulations require that meters should be presented to the inspector for inspection. To test in situ is extremely inconvenient and sometimes impossible. An extra fee of 50 cents is charged for meters so tested.

3. A good photometer set with standardized incandescent lamps, a low reading wattmeter and a voltmeter.

5. 5 or 8 c.p. lamps should be freely supplied to meter customers to enable them to regulate their purchases. It would tend to promote harmony as well as good business.

10. Bring the criminal code to bear on the guilty parties.

11. If wires were so marked it would doubtless be a source of great help and protection to linemen.

13. The experience of Government inspectors is that meters constructed for 60 cycles will not keep within the tolerated error if used on 125 cycles and vice versa. In all cases, so far as the Government inspection is concerned, meters are tested on the same frequency as is marked on the meter.

27. By removing the fuse wire in the fuse block on the opposite side of the one on which the supply meter is connected and bringing the current wires of an indicating wattmeter to the points thus made available and connecting the potential wire to the other side. The supply meter would not then be disturbed.

28. Most meters run slow with only 5% of full load. Except for sensitiveness the Government inspectors do not test meters on less than 25% full load.

W. A. Johnston, United Electric Company, Toronto :

Referring to question number 14: Single phase inductor alternators have been manufactured for the last three or four years in Toronto under patents of the writer. Such a machine was manufactured at first by the W. A. Johnson Electric Company and later by the United Electric Company. They may be seen in constant use in the following towns : Beeton, Acton, Norwood, Bedford, Que., Colborne, Ont., Goderich, Ont., Hamburg, Ont., Seaforth, Ont., etc. Such machines have operated successfully, running very cool and having perfect inherent regulation; it is the writer's believe that owing to imperfect regulation, and also in some cases to excessive heat, other makers have not seen fit to exploit the sale of single phase inductor alternators, and in fact some makers have practically abandoned polyphase inductor alternators for practically similar reasons.

The whole question is really one of correctness in design. The paper by the writer published about three years ago in the ELECTRICAL NEWS fully covers the ground.

The question which might enlarge the discussion in this line would be, "Why are such good results regarding regulation obtained in transformers as made by almost any manufacturer, whereas when same iron and copper is used to construct a generator poor regulation is obtained and usually the endeavor is made to compensate for or correct such irregular generator by use of compound windings, etc."

Brantford Electric & Operating Company :

In answer to question No. 9, "What is the best way of keeping track of transformers, their location, sizes, and the maximum active load on them," we have found our system in use here for keeping track of the above very satisfactory, and same has often been the means of saving transformers from burn-outs due to overloads. When a customer is connected, and the order of same is returned, the transformer number is handed in by the foreman. This number is placed on the customer's card, and the customer's name, together with the number of lights and the estimated average maximum load, is entered on a card, which is filed in a card index, according to the transformer number. This card, which is 4 to 6 inches, shows in addition to the number, the size, make, voltage and type, and also shows the date purchased, from whom, and the price. Columns are left on the face of it for the date of installation, circuit, location and date and reason for removal if any. On the back of the card three columns are provided, one for customer's name, one for number of lights connected, and the other for the estimated average load. These cards show at any time the number of lights connected on each transformer and also furnish a rapid means of finding out the numbers and sizes of transformers connected on the lines. We enclose herewith copies of transformer cards in use by us.

(Front of Card.)

Size of Transformer.	Make.	No.
Voltage.	Type.	Inst. by.
Purchased.	Bo't from.	Price.
Installed. Phase.	Location.	Removed and Reasons.

(Back of Card.)

No. Lights.	CUSTOMER.	Aver. Load.

Mr. Hunt: Mr. President, the meeting of the Executive this morning was kind enough to appoint Mr. Dion and myself to take charge of this Question Box. I might state that in the National Electric Light Association of the United States, which held its meeting in Chicago this year, we had a great many questions, nearly three hundred, put in by members during the year. The Secretary sends out papers about every month with the questions that have been submitted and each member is requested to answer, if he can, one or more of the questions that have been sent in, and by that means a great many answers are obtained before the meeting—so much so that when we met in Chicago this year the Secretary had a book almost half an inch thick printed with the questions and the answers following. We found it of very great assistance. I might say some of those books have been sent to members of this Association, and I heard one gentleman this morning say he thought it was the most valuable book printed in the electrical line. Next year the Executive Committee might, I suppose, find it possible to do this work in a similar way and save a lot of discussion at our meetings which takes up time. However, we must make a beginning, and with your permission I will read the first question and ask some of the gentlemen present to give us their views on it. The first question sent in is one of very great importance and I think possibly there is some difference of opinion on it. "Is it advisable to "ground" secondaries at the transformer or in the building supplied?" I might state here that there was some difference of opinion among the Chicago members, some saying it was better not to ground them at all and others contending that it was.

The President: Perhaps some member present could give an answer to that or give his opinion about it—some central station man.

Mr. Fisk: Mr. President, I might say at Peterboro we are grounding all of our late secondary work, especially the three wire; ground the neutral and ground at the transformer, and so far we have not grounded anything in the building. It has worked very satisfactorily.

Mr Dion: May I ask Mr. Fisk what means he takes for grounding on the streets?

Mr. Fisk: Simply put a copper plate down in the ground about seven inches deep, about twelve inches square, nailed to the bottom of the pole, and a copper wire soldered to that.

Mr. Dion: Do you know of any breaking of the joint?

Mr. Fisk: We have never found it so.

The President: I think good moist ground would be sufficient one way or the other.

Mr. Higman: It seems to me that the most effective way of doing it, if it is desirable to do it at all, and I believe it is, is to ground the secondary at the transformer. I do not think the plan adopted by Mr. Fisk is a desirable one. Electrolytic action will soon destroy the connection and there will be no ground. The only effective way is to string an iron wire of good size grounded at some central point. The grounding of the secondary is quite a common and usual practice in Europe.

Mr. Hunt: Where do you run the iron wire?

Mr. Higman: On the poles, following the transformers.

Mr. Hunt: I understand that the National Board of Underwriters have now some objection to grounding at the transformers. It seems there has been trouble through having grounds at the transformer and also from grounding inside of buildings where there are water and gas pipes. There have been some fires caused on that account, where the ground wire is crossed by a water or gas pipe in the building.

Mr. Dion: I think the question is not exactly whether we should ground secondaries or not. The question upon which there seems to be considerable difference of opinion is whether we should ground the secondaries at the transformer or in the building. It seems to me we have no choice in the matter, because the National Code will not allow grounding except outside the building. If you ground it outside of the building it seems to me it is a matter of indifference whether it is immediately outside or half way to the pole or at the transformer. There is a written answer which I wish to read to read to you. Mr. Sangster, of Sherbrooke, says: "At the transformer."

Mr. Hunt: The next question is: Should meters be tested in place or should they be returned to the station for that purpose?" There are two answers to that, one from the Sherbrooke Power, Light & Heat Company: "In some cases in place; in others taken to the station." Another answer, from Mr. Higman, is: "Government regulations require that meters should be presented to the inspector for inspection. To test in situ is extremely inconvenient and sometimes impossible. An extra fee of fifty cents is charged for meters so tested."

The President: Are there any other answers to that?

Mr. Fisk: We bring all our meters in for inspection. It is almost impossible to do anything to a meter that is on the premises, if found incorrect. We have found it better to bring them in where everything is handy for correcting the meter if it is wrong.

Mr. Higman: In many instances the meters are tested on the company's premises; that is the case in Toronto. Accommodation is made for testing the meters and the representatives of the companies and our own inspectors work together. It would seem to me, apart from the regulation, to be desirable to bring meters in and give them a general overhauling and cleaning up. Some meters are placed in positions where it would be absolutely impossible to adjust them; they are stuck away up in a dark closet near the ceiling; we find many of them in such positions. There are no conveniences at all for testing meters in situ and for this reason we do not encourage the practice.

Mr. Yule: I would like to ask Mr. Higman if it is not found, in the case of disputed accounts where the correctness of the meter is disputed, that if the meter is first tested on the premises, and they are notified to be present, that it gives added confidence in the decision of the officials? My opinion is that it would, where that was done.

Mr. Higman: Possibly. But the regulation states that in case of a disputed meter the seal shall only be broken by the inspector; no other party would be able to tamper with the meter.

Mr. Yule: I say to test it as it stands and is connected on the premises.

Mr. Higman: If you can make a satisfactory test it is alright.

Mr. Saxby: I think we should have the privilege of having the meters inspected on the premises, because in that case where there is a large bank the labor would be done away with.

Mr. Higman: In the case of 500 volt power meters, they are often tested where they are in use.

Mr. A. Sangster: I have had occasion to test them in the premises sometimes. This past week I had occasion to take out two meters. The customers thought they were going too fast. In one instance one of them was five per cent. slow and in that case the customer said that we had tampered with the meter before we tested it. Therefore, I state in some cases it is necessary to test them in place. It is according to the customer you have to deal with. I gave the answer according to my experience. The only way to do it is by putting on the lamps and running for an hour without touching the seal or anything and then showing the reading; then if the customer is not satisfied we take the meter out and take it away for Government inspection, and give the customer notice of the Government test so that he may see the meters tested if he wishes.

The President: It is a good practice and one which we have followed. We have invariably brought our meters into the bank where the Government inspectors test them, but it is a good plan in some cases to put another tested meter in parallel with the one that is in place and let the cutomer see how they run and tally one with the other. It works very well, I think.

Mr. Higman : Of course, the disputed meter could be handed over to the inspector in the presence of the customer.

Mr. Purcell : I have in mind one meter, and when we tested it in the shop it ran alright, and we sent it out and had it put up and in one month that meter had crept 24 kilowatt hours. There was vibration in the building in which it was put up. There was no vibration in the building in which it was tested. I think there are some instances in which you have to make tests on the premises.

Mr. Saxby : I had one case of that myself in connection with one of the old type of meters. I noticed the very thing that Mr. Purcell has mentioned, that the meter started to run faster with the vibration.

Mr. Purcell : I might say the Edison people in the city of Detroit insist on all meters being tested on the third floor of their power house, where there is a great deal of vibration. Originally they used to receive their Thomson meters from the General Electric Company that were tested on an air bag so as to eliminate all vibration that there might be. When the meters were received and put up for test they found that they were possibly anywhere from ten to twenty per cent. fast. They specified that these meters must not be tested on the air bag ; they must be fastened to the wall or shaft or anything convenient so as to be liable to the vibration of the building—every day conditions—and that they do now ; they test all their meters on the third floor of their power house where there is vibration from the machinery which is below, and they get every-day conditions, and as a result they have very few objections. Of course, on the other side they have no Government meter inspection for electric light, it is simply their own inspection, and they make a very close inspection. Mr. Clarke, who had charge of that department, is quite a capable man. I was very much pleased with the way he explained things for me in connection with that matter when in the city of Detroit five or six weeks ago. We have vibration from trains as well, in the building I refer to, and those meters when tested on the premises and in the shop show a difference of fully five per cent. and possibly a little more than that.

Mr. Higman : I might say in a general way that the percentage of meters that run outside of the toleration of error allowed is very small even after working for some years, and these are cases that it would be almost impossible to make any general rule to meet. You will find these exceptional cases ; I do not see that we could make any provision for them.

Mr. Purcell : With reference to testing the meter on the premises, we make it a rule that the wiring must be run to a point which is easy of access, not more than eight feet high, on the wall.

Dr. Johnson : Although in the employ of the Government, I have taken the liberty of sometimes not adhering closely to the rule. In cases where people have doubted the accuracy of their meters and thought they preferred to see a test on the premises, I have done so to please them without any extra charge. It is very seldom I have to do it. As a rule they are quite satisfied to see the meter taken away, and I usually ask them to be present at the test. When they see the seal broken by me or some of my assistants and see the test made they are always satisfied. I hardly ever had a case where there was any doubt thrown out about it being interfered with. I always bring to their attention the fact that the seal is there and has been unbroken until it is broken by me, and they nearly always have been satisfied, but once in a while we test on the premises if they desire that.

Mr. Yule : I would like to congratulate Mr. Higman on the entire absence of punctiliousness amongst the officials in his department ; they do their duty and do what is right and take special pains to deal with the customers.

Mr. Higman : That calls for one word more from me and it is this : That from the very outset I have laid down the principle that people engaged in the electric lighting industry were honest men trying to do the best for their customers. I have never yet found a single instance where an electric light company laid itself out to cheat the public. Working along those lines we have experienced no difficulty in maintaining amicable relations with this important industry. (Applause.)

Mr. Hunt : Question No. 3 is : What systems are mostly used and commendable to check up lamp manufacturers' guarantees as to life, efficiency and "c.p."? I have one or two answers to that : Mr. Higman suggests a good photometer set with standardized incandescent lamps ; a low reading wattmeter and a voltmeter. I think that covers the whole thing because it is not very extreme and it is very efficient.

Mr. Fisk : It is well to add to that a competent man with very little else to do.

Mr. Dion : This question perhaps may be taken in another way : What is the best system of testing incandescent lamps? It may be put in other words : What means do you take to ascertain whether your lamps are correct or not? Apart altogether from the instruments which you use there may be different ways of getting at that. For instance, it is not practical to test every lamp, but a certain percentage may be tested. The system we use, which is probably the same as that used by a great many other companies, is this, we take five per cent. of all the lamps we get ; for instance, in a package of 300 lamps we would take fifteen lamps at random and put them through a photometer test and also connect them with a wattmeter immediately after and note the candle power and the wattage, and we plot that on a printed form with a target in the centre, and the lamps must test within the allowable limits of candle power and wattage. These limits are set when we make our contracts with the lamp manufacturer and form the boundaries of this target. We insist that at least sixty per cent., three out of five, of the lamps tested shall fall within that target—that is our rule—and if we don't get this result the whole package is returned to the factory. Those are the terms of the contract and we try to follow them up. We might test a larger percentage of lamps, but some such system as that must be followed, because you cannot very well test every lamp. Then apart from that lamps are selected from time to time, one or two out of the package, and put on a board for life test. This part of it, I am sorry to say, has not been carried out very systematically. We have not carried on life tests continually, but we from time to time made life tests. With regard to the remark by Mr. Fisk as to a competent man, we found that a young man who was the store-keeper—had charge of the lamp stores and some other things besides—was quite competent to do this. He was put in charge and took a lively interest in it. He was coached for a while and soon gave very good satisfaction. We had a dispute last year with our manufacturers and a lot of 25 lamps was sent to the testing bureau as a referee, and we were glad to note that our store-keeper was doing very well. So that I do not see that it is necessary to get a expert; I think an ordinarily intelligent man can be coached to do that. I do not say that he would do in a lamp factory or where you want particularly accurate tests, but for the ordinary run of commercial tests I think it can be done in that way. We use standardized lamps. Our standards are supplied by the lamp testing bureau of the United States, they have two grades, a cheap standard and a closer standard which is more expensive; they cost $2.50 a piece, I think.

Mr. Hunt : The next question is No. 4 : "What has been the experience in operating single phase motors on lighting circuits and to what size of motors is such operation practically limited ?"

Mr. Lambe : I don't recall anything larger than about five horse-power, generally smaller in this country.

Mr. Russell : I am representing the Wagner Electric Mfg. Company, builders of single phase motors, and although I cannot give you any particular data still I can speak from general information. It seems that the size of the motor which you can operate on lighting circuits depends to a great extent on your own local conditions. Now, take Newark, N. J., they are using as high as a 35 horse-power on their system, which is multiphase ; there are other systems where they have less than 100 kilowatt generator capacity, and they have 30 horsepower motors ; take in some cities they are only allowing as high as 5 horse power. Central station managers, it seems, will put on any size of motor which can be placed on a circuit, and the load being thrown on and off, will not give them a greater fluctuation in voltage than they can stand for proper service to their customers.

Mr. Hunt : That depends on your transformers and your line ?

Mr. Russell : That depends on your line capacity.

Mr. Higman : What is the largest motor you make on single phase ?

Mr. Russell : 35 horse power.

At 12.45 o'clock p. m., the Convention adjourned for luncheon.

AFTERNOON SESSION.

2.30 o'clock p.m., the President called the Convention to order, and called upon Mr. C. F. Scott, Pittsburgh, Pa., to read a paper by Mr. Paul Lincoln, Pittsburg, Pa., on "The High Tension Engineer."

Mr. Scott read the paper, which is printed elsewhere.

Mr. Chas. F. Scott : In conversation a little while ago this question was asked : How has the advance in electrical engineering in High Tension work been conducted in the past, who has done it ? A gentleman replied : Mainly by the manufacturing companies. I think this is true—these companies have developed experts ; they have sent these experts out over the country ; they have built new lines of apparatus, carried on laboratories and investigated to determine what is most suited to meet your conditions. The primary business of these companies is to manufacture apparatus but they have had to come and take the place of the consulting engineer and the text book ; they have had to develop the engineering itself and to tell you what you need and how to operate it as well as to build and to sell you the apparatus. Is it not time that you gentlemen co-operate now in contributing the experience which you have, either formally through your Association, or as individuals ? In what way ? You can contribute of your experience to help along this profession upon which we are all so dependent.

The manufacturing companies have also taken the lead of the operating companies in appreciating the value of the young electrical graduate in their business. They have provided apprentice courses ; they take them in large numbers ; they educate them for their own work and for you. This, the engineering work, the experimental work which they have done, must be paid for and is paid for naturally through the apparatus which you buy. As you assist in cutting off that element of their expense it will be a factor in cheapening the cost of electrical apparatus. I am glad to appear before you and speak as President of the American Institute of Electrical Engineers. I am very glad to be present to-day and to see such a substantial gathering of electrical men on this side of the border. The American Institute has been broadening in its work not only in connection with power transmission as Mr. Lincoln has pointed out, but in other lines also; it has felt it should be in touch with more men and particularly with the younger men who are growing up in the profession. It has presented to young engineers and to older ones as well the advantages of becoming members of the Institute and also the responsibility which they ought to feel to accord their support to an institution of the character and of the activity which the American Institute has. Formerly the American Institute has had its monthly meetings in New York which have been attended by a local audience. There have been one or two other places where meetings have been held, but this year a great extension has been made by the formation of local branches. They have been formed in the principal cities ; in Boston, Washington, Philadelphia, St. Louis, Cincinnati, Denver, Pittsburgh and in other places ; the one in Chicago which had existed before has taken on new life. Meetings have been started also in a large number of colleges. College professors meet with their students, or an engineering society of students constitutes itself into an institute meeting. At these local branches the papers presented in New York, together with the discussion of the papers held in New York, are presented, so that the local branches have better material than the New York meeting itself, having the discussion in addition to the papers. This has awakened a good deal of interest and activity and it has taken very well among the college boys, and a number of professors have said to me that the results were of far greater value than they had anticipated. Within the last week I have had the pleasure in our secretary's office of reading over a report which has come from Toronto of the formation within the last two weeks here of a local branch of the Institute for the purpose of taking up Institute papers and strengthening the institute in this region. I think that is a most excellent move and I predict success for it. In these later days we are beginning to appreciate more fully the value and importance and meaning of co-operation ; it is coming among engineers, I think brought about very largely through the electrical engineer ; he does not do very much himself ; off by himself he does not amount to much ; he has to come in and stir up the other engineers. The hydraulic engineer had a quiet sort of a time until the electrical engineer got after him. Now he has to work ten times as hard. The steam engine men gave any old kind of an engine and it did the business for a while, but when the engine had to run a dynamo there were new speed requirements. The mechanical shop engineer did not have to know very much except to run a shaft and figure out the size of a pulley, but when the electrical engineer got into the machine shop he revolutionized the whole thing. The tools now are not strong enough. I think it means a great deal ; it points to the tendency in modern times when we look at a little incident like this : The superintendent of our factory at Pittsburg made the remark with reference to tools that were being bought for an extension of the factory, that although the tools were no larger, yet an expense of something like fifty per cent. additional was being paid in order that the tools might be made to run faster and do more work on account of the conditions which had come in through the new kinds of tool steel and through the electric drive. The electrical engineer binds together other engineers instead of working independently. I instance the Pennsylvania tunnel in New York, where civil and mechanical and hydraulic and mining engineers are interested along with the electrical engineer. All have to work together. That is one of the points to remember and observe with respect to this young man we are trying to develop and bring up to handle our work properly. He needs to be all kinds of an engineer ; he needs to know how to develop, to match up and fit in all kinds of engineering work. The dynamo man is one of the smallest men about the whole concern. Down in Pittsburg the big dynamos for Niagara Falls used to overawe everything else in sight. Of course, water wheels are common and didn't seem to amount to very much ; the dynamo was the great thing. But when I got up to Niagara Falls and saw those little insignificant machines in so large a station and when I went down into that great wheel-pit and heard that noise and saw those long shafts and those great big water pipes and all that sort of thing it seemed to me that the dynamo was the smallest part of it all. But it is the electrical engineer who must see all the other things fit in and work together. The electrical system is the central system ; all the other have to fit to it and be satisfactory to the electrical conditions. Now, regarding co-operation, one of the men who has been most successful in industrial work in this country in building up a magnificent organization, who has given great attention to the mechanical processes, who has believed in throwing away a thing quickly as soon as there was something better in sight, a man who has built up a great company, by getting men who knew more about each branch of the business than he did himself of organizing the men as well as the machinery, the man who has amassed a great fortune, one of the greatest the world has ever known, this man has recognized the advantage of engineering work and of engineering societies and of co-operation--"engineers need to get together" are his words—and he has done one of the most magnificent things towards co-operation and towards engineering work in its broadest sense, and that man is Mr. Carnegie, and the act is the gift of $1,000,000 towards a great engineering building in New York for the National Engineering Societies. (Applause) These big societies are being recognized; a practical man has recognized them; and these other societies, these societies, such as yours, which take a particular line of work in a particular part of the country, they should recognize they have a part in the onward advance of work of this kind. I ask you as individuals and officially as members of the Canadian Electrical Association to consider that the American Institute of Electrical Engineers is ready and glad to co-operate with you as a society or as individuals and to receive your assistance in pushing forward the work which it has undertaken. (Applause)

The President: This is a valuable paper which we have had and it has given time to follow it up a little. If Mr. Black is in the room I would like if he would give us a little information or a few pointers.

Mr. Dion: I understand Prof. Owens is here; he is professor in the leading school of electrical engineering in this counry; I should be glad to hear from him as to the college end of the discussion.

Prof. Owens: Both Mr. Lincoln and Mr. Scott have outlined the relations which should and in the main do exist between the college and outside work so clearly that remarks by me are hardly necessary. However, it may be said that within comparatively few years there did not exist as complete and as satisfactory an understanding between the college people and the manufacturing word as now, I am glad to say, does exist, due in large part to the interest in college work shown by such men as Mr. Scott, Mr. Lincoln, the officers of the General Electric, the Bullock and other large manufacturing companies. They now perfectly well understand, I think, that a college does all that it can be expected to do when, in the short time it has at its disposal, it gives to students some knowledge of the fundimental principles which underlie all engineering work. The tendency in engineering education now, as far as I am able to observe, is to instruct in the principles. No university can operate a manufacturing establishment and give to the students a knowledge of manufacturing details. It is quite out of the question. It is most significant, however, that the majority of the larger electric manufacturing companies select their young men almost entirely from college graduates, saying at the same time that they do not expect every man who comes from the college to make a engineer, but that it is the best material from which to draw. Now, I believe that their are men going out from colleges to-day perhaps better trained than they were only a few years ago. To me, as a man connected with an engineering school, I must say that if it is so it is largely due to the interest and assistance of outside men. I remember very perfectly the difficulty ten or twelve years ago I experienced in obtaining permission to visit the works of one of the larger companies, but I was fortunate enough at that time to know Mr. Scott and I got into the Westinghouse Company, where I spent one summer. If you, gentlemen, who own and operate lighting plants desire your engineer to further inform himselt about high tension work or some special form of new apparatus that any of the larger companies is manufacturing you may send him to such a factory and he will be kindly received and will be shown everything, and he will go away with very much more information than he had when he came. In line with what Mr. Scott had said you might also send your men on trips of inspection for the purpose of studying local conditions which are similar perhaps to those which obtain in your own plant. If the college education is supplemented by this sort of training you will then have or should have an engineer. The college does not make you an engineer, the college graduate is not an engineer. But he is a man who is much more likely to become quickly an engineer than a man who has not had the college training, yet it is only the beginning of his work; nothing in the world can take the place of experience. A man is not an engineer until he is supplemented in the knowledge of the principle with experience. I think that is very well understood now both by college men and those who are employing engineers, and it is largely due to such gentlemen as Mr. Scott and others who have spoken.

Mr. Black: Mr. Scott and Prof. Owens have spoken for the educational and manufacturing end of the subject, and I might say a word with regard to the operating end of a transmission plant. I was very much struck with one remark to the effect that when things were designed and planned out so that you would naturally expect them to work perfectly, that did not always work that way. I think that has been the experience of everybody who has had to do with the operation of electrical machinery. I was much pleased to notice what Mr. Scott said about engineers getting together and trying to work together for the benefit of electrical engineers at large. It is very gratifying to younger engineers to find men of large experience who are willing to give them the advantage of their experience.

Mr. Lozier: If I may take the floor for a minute. In the subject that has been discussed the point which seems to be of the greatest interest to all is the preparation of the electrical engineer for his work. We have heard from Prof. Owens that they prepare him for his work; we have heard from Mr. Scott how they finish the product. I have had a good deal of experience with young men going through the shops, in the expert course, and if there is one suggestion that I might offer it would be this, a man goes to college and he will probably take a four years course. Many of the men who go to college feel when the summer holidays come it is a good time to rest up. That may be be very true, but it is also a very excellent chance for those men to learn during the summer holidays what would be most useful to them during the next term of college. I don't know whether it would be too radical to suggest that for an electrical engineer it would be of advantage to him if he could take a shop or practical course, so as to get a short experience the first year before he goes to college so that he would be familiar with the things which he would afterwards learn in the text books. If there is any virtue in the suggestion at all it would be to mix the two together as far as circumstances enable a young man to do so.

Prof. Owens: In line with what Mr. Lozier has just said, it may be of interest to state that in McGill University at any rate the students are required to spend three months of each summer term in practical work, and we find it of the highsst possible advantage to them.

Mr. Scott: If you will allow me, I don't think we are hearing enough from the other side. This general subject was under discussion at the convention of the National Electric Light Association at Chicago a week or two ago and one of the station men said this; The trouble with the young engineer in the electric light plant is the manager of the electric light plant; the manager and the people around the electric light plant, when a young engineer comes in, they secret their information; they keep it away from him, they do not give him anything. Prsident Pritchett, of the Massachusetts Institute of Technology, not long ago went through a factory in which he found a Returned Material Department; he was very much interested in that; things which did not work right came back, and the company gave particular attention to find out why, whether it was some fundamental lack in the design or some fault in the construction or whether it had been misused. He said he thought colleges ought to have Returned Material Departments to find out why it was that these young men who went out did not always succeed. You are the men who use the apparatus and use the students, and if the apparatus is not right you send it back in a hurry, whether you explain fully what is the matter or not; you may not be too explicit about it, but the apparatus comes back all the same. What about the students? Is Prof. Owens turning out the right kind of students and if not why not, what is the matter with them? I think it was that retired merchant in his letters to his son who said "The college does not make fools, it only develops them. And it does not make intelligent and able men, it only develops them." You have got to have the right kind of material to start with and the college can help it along. If you get the wrong kind of fellow that has come through college he will never make the right kind of engineer. Is that the kind of fellow you have got? Have you had some of these young engineers who have been more bother than they are worth, or not? Let us hear from the other side.

Mr. Dion: Speaking on the subject of Mr. Scott's discourse I think the reason why he does not get a response when he asks central station managers to give their experience with regard to college graduates is the fact that the college graduates have not been employed in any large numbers by the operating companies in this country. I think it has been the custom largely—probably owing to the fact that the companies are small compared with those of the larger cities in the United States—for the men to be drawn largely from local material which has been trained up in a practical way to fill the different positions in the operating department. Graduates have mostly gone over to the United States and they have acquired some practical experience there, and they sometimes come back to take important positions here, but their practical training had been obtained mostly on the other side after they left college. One thing that occured to me during the discussion was this, that university professors whom I have heard on the subject or whose opinions I have read, as well as the leading engineers in the manufacturing companies, men who have had experience with graduates, all seem to agree that the colleges do not produce engineers but only prepare material to make engineers. This seems to be generally recognized. Nevertheless, it is a practice of colleges to grant degrees and to give a man the title of "Electrical Engineer," and this, it seems to me, has led to some little misunderstanding with the employing public who sometimes do not understand the practice of the universities in that respect. I remember a few years ago, following an animated discussion in the electrical press of the United States as to whether graduates should be labelled "Electrical Engineers" or something else, and some of the professors of the universities as well as outsiders held that the degree should be known by some other name, Bachelor of Engineering, or something of that sort. However, I think this Association is going to benefit and all the members who are here to-day will certainly benefit by the remarks of Mr. Scott on a subject which he handles so well. I personally believe in co-operation. I think it is impossible to accomplish very much in any line of effort without co-operation, and Mr. Scott has shown himself to be a very strong advocate of it. He has pleaded for it on every occasion when he has had an opportunity to express himself, and I do not know of any man in America who has done more towards co-operation or towards what will produce in the near future active co-operation between the different engineering bodies than Mr. Scott has done during the past twelve months. (Applause) I think if we knew the true inwardness of the Carnegie grant Mr. Scott would be found to have had a good deal to do with it. He has told you of the progress that has been made by the American Institute of Electrical Engineers during the past year; this progress has seemed most remarkable even to those who are at a distance and cannot keep in close touch with the Institute; and this result is due in a large measure to Mr. Scott's personal efforts as President of the Institute. Any one who has followed the work of the Institute at all must recognize that fact. I have very much pleasure in moving a vote of thanks to Mr. Lincoln, who wrote the paper, and to Mr. Scott, who supplemented it by a discourse of such benefit to this Association.

Mr. Hunt: I have great pleasure in seconding that. I might say I was at Chicago the week before last. I know that the National Electric Light Association took deep interest in anything that Mr. Scott had to say to them; they were very glad to hear from him.

The President put the motion, which, on a vote having been taken, was declared carried amid applause.

Mr. Scott: I thank you very much. If I may be allowed one more remark I would like to say this: One gentleman in speaking in discussion called attention to the exchange of experience; at the National Electric Light Association in Chicago there was an admirable example. During the year different members of the Association by request had sent in questions that they would like to have answered. These questions covered a very great variety: "What has been most satisfactory in small towns, meter or flat rates or a combination?" "What is the best incandescent lamp base to adopt and why?" "What methods have been used to provide a fairly uniform temperature for storage batteries of a given capacity?" "What is the best method of making temporary repair to a belt 16 inches in width?" These are a few of the questions selected at random. They cover the whole range of station experience. These 257 questions were then sent out to the different members of the Association for reply and most of these questions have from two or three to half a dozen replies, signed by the men who made them. 125 different individuals have replied, some of them to one question, some to as many as 100 questions. It seems to me that this is one of the best things, one of the best undertakings and the best work that I have ever seen for accomplishing its purpose, and I am very glad to see that your Association is taking up some of the same kind of work. The American Institute of Electrical Engineers, I think I omitted to state specifically, would be very glad to see any of you gentlemen at its convention in Niagara Falls the last two days of this month and the first two days of next month. (Applause)

On motion of Mr. Hunt the convention adjourned until Thursday morning.

SECOND DAY.

At 10.15 o'clock a.m. the President took the chair and called the convention to order.

The President named as the Select Committee to strike the Standing Committees: Messrs A. A. Dion, Ottawa; John Yule, Guelph; and W. Williams, Sarnia; after which he called upon Mr. Lozier, of Cincinnati, Ohio, to read his paper on "Variable Speed Motors and Their Relation to the New Shop Methods."

Mr. Lozier read his paper, which is printed elsewhere.

In connection with his paper Mr. Lozier used the Cooper curve, which was shown on a diagram, and which he explained to those present.

The President: You have heard this valuable paper by Mr. Lozier. There should be discussion upon it as it is a question of vital interest to a great many central station people, especially those supplying power.

Mr. Hines: I would like to ask Mr. Lozier as to the relative cost of maintenance of the multivoltage and direct current motor systems, as applied to small loads.

Mr. Lozier: Mr. Hines has touched on a very important point. There are two considerations involved in this proposition, one is the investment which carries with it depreciation, and the other is what you are going to get out of this investment. We ought to give due consideration to both of these points. The direct current motor that is being used to-day on tool practice is quite a different kind of a bird to the motors that have been used in the past. The depreciation of these motors is very low. In the first place the motor does not run at its full capacity all the time and in the second place it has actually no sparking, it is designed so that it won't spark. The depreciation is rather difficult to state exactly, but I think we are quite safe in saying it will not in any event exceed six per cent. Very good. We will take that as a fixed quantity. Now, against this depreciation we have: What can the motor do? When we are considering this six per cent. depreciation we want to figure what that will cost on the investment. We will take a concrete case. We will say a tool equipment for a shop costs $50,000 and we will take six per cent. of that as the depreciation or $3,000, and we will say that $50,000 equipment is sufficient for an establishment turning out $1,000,000 worth of stuff. That is a pretty big equipment for that output but we will take it on that basis. Take six per cent. on that it gives $3,000 as our depreciation account. We will double it; we will say the depreciation is $6,000, and multiply it by four and say it is $12,000; in other words we are assuming a depreciation of 24 per cent. and that our motors will only last for about four years; we will say $24,000 is our depreciation. In that case we have got an equipment turning out $1,000,000 worth of stuff a year. With the individual directly applied motor we can increase the output of that shop perhaps 30 or 40 per cent., but let us take for this comparison about 10 per cent. which now gives us an output of $1,000,000 + $100,000 or $1,100,000 output; we are going to take 10 per cent. more out of it with the same ffxed charges and the same pay roll; we have got to use a lit'le more material; we have got $100,000 to the good; we will take out for material 20 per cent.; so we have got $80,000 increased value of production against $24,000 which is the exaggerated depreciation we assumed to illustrate the case. Now, you can use a pretty expensive kind of a motor on a proposition of that kind. Does that cover the point?

Mr. Hines: that covers the point.

Mr. Gossler: Mr. Chairman, there was another point touched upon in Mr. Lozier's paper and one which I think very important especially from the operating point of view. I have reference to the individual tools giving a higher output for the same investment or rather increasing the load factor of the shop. I think the experience I have had up to the present, shows that the load factor of a shop, especially a machine shop, is somewhere between 30 and 60 per cent., I think 60 is very high; consequently the charge which should be properly based for power on maxium demand will have to be greater than if the load factor was higher. Anything that has a tendency to increase the load factor or keep constant the maximum demand for power, will certainly permit of decreasing the cost of the power. Another point that has been touched on slightly here by the first speaker, is that of alternating and direct current motors. I think it is well established that the general system of distribution is that of the alternating current, and anything that will tend to simplify the system and permit of the use of alternating current motors, I think will be a very great step in the progress of the utilization of motors directly connected to individual machines. I trust that matter will be dwelt upon by those capable to speak upon it.

Mr. Hims: I would say if we could have an alternating variable speed motor undoubtedly we would have the ideal factor in shop development, but unfortunately we not able to vary the speed of an alternating motor except within certain limits. Now, of course, in the system of distribution the alternating motor is far simpler than the direct current motor, we grant, but the direct motor appears in the machine shop to be far more flexible with the maximum out-put. If you put a man at a machine on the piece work system and you want to get all out of the machine and man you can it would appear to me from the present standpoint that the direct current motor was best adapted for that work even allowing a large depreciation, but it seems to me with the increased out-put and the figures Mr. Lozier gives all the economy of the alternating current motor and distribution system would be more than counter-balanced by the increased out-put obtained from the direct current motor. There seems to be a large diversity of opinion as to whether it is best to equip with the direct current motor and apply individual motors to almost every tool of 5 h.p. or over or put in the alternating current motor and group your tools.

Mr. Leonard: Mr. President, this matter of shop operation is particularly interesting to me just at present, and I have been thinking about it a little. Our conditions in Canada are peculiar because all our plants are operating on the alternating current system and it is rather difficult to obtain the direct current for variable speed purposes unless some means of convertion—a motor generator set or something of that sort—is utilized. Under those conditions for shop operations it strikes me that a system employing alternating current induction motors for all constant speed work is the ideal system that would be carried out, according to my ideas, as far as possible in heavy tools running at constant speed, on group tools, on galleries or portions of the shop not served by cranes; the balance of the shop, as for instance the lath work and portions of the shop where heavy tooling is to be done, would be operated by a variable speed method using direct current motors. To obtain this class of current from the central station it would, of course, be necessary to use a motor generator set, but, as Mr. Lozier has pointed out, the cost of this set and its depreciation cuts so small a figure on the output of the plant that it is hardly worth consideration. To be sure it involves an extra loss in the mere matter of transformation. But utilizing, as I suggested, the alternating current for heavy tools at constant speed and then operating all the variable speed work with direct current motors gives a system which, it strikes me, fits the machine shop practice in this country as closely as anything that can be obtained.

Mr. Hines: There is another fact that has to be taken into consideration and that is the transformer losses.

Mr. Leonard: Without prolonging the discussion too far, transformer losses are involved by the alternating current system, but the transformer losses only equal the line losses in the direct current system. To make the allowance for a rotary transformer or a motor generator set, there are losses no doubt with our system in Canada which are losses from the alternating system, which become necessary if the direct current is used, so that we not only have the alternating current transformer losses connected with the central station but we also have the rotary transformer losses in order to obtain the direct current. Notwithstanding all this the percentages are so small that considering the advantages for variable speeds I think probably in most cases it will be advisable to use part of both styles of motors.

Mr. Lozier: If I may take a minute, the proposition that Mr. Leonard makes of the combination of the alternating current motor with the direct current motor may be very true. I am talking about the variable speed motor in its application to new machine shop practice. And if the alternating current motor has any advantages for constant speed work that the direct current motor has not got, by all means use it. Abe Lincoln says, "If you like that kind that is the kind you like." But, there are a whole lot of things to be borne in mind; the question has to be gone over very carefully, for in the first place the advantages of the alternating current motor over the direct are not so great from the sparking standpoint as they used to be. The compound direct current motor is a very good servant, highly efficient, good on starting torque, has not got any power factor, it is a good mechanical device. Another thing that you must bear in mind, and I am not advocating against the alternating current motor when I say this, and that is the interchangeability of your motors. The modern machine shop to-day places the order with the manufacturer for one dozen 6 h.p. motors, shunt wound, speed 600 revolutions, voltage 120, or twelve 10 h. p. motors, speed 600 revolutions, etc., and it takes those motors out of its storeroom shelves the same as it would go there and get so many lines of shafting or so many pulleys. The sooner you can get this system interchangeable the better you are off. If you are going to put in motor generator sets for your direct current motors you might as well carry that system throughout your shop, provided changing to the alternating current for your tools does not possess to your mind some advantage that sticking consistently to a given plan does not. This is a matter that is essentially practical to us, and one that goes very deeply into shop economics ; it is a matter in which the personal equation is very largely involved ; you have got to study your men and you have got to give them something they thoroughly understand. Your system has got to be fool proof. The superintendents that are putting it in are not accustomed to it ; you give them a complex proposition and it stops them. I know of a case to-day of a very intelligent shop superintendent who is devoting his present time to studying electricity with us and he came back with questions like this : "Well, you have a compound wound motor and you have a series motor and you have a shunt wound motor ?" "Yes."

"Does it make any difference whether you put your series field on one side of the armature or on the other ?" "No."

"Does it make any difference whether you get your shunt field in this way or that way ?" "Oh yes."

"You have a compound wound generator ?" "Yes."

"You have shunt wound generators ?" "Sometimes."

"What is the difference between a compound wound generator and a compound wound motor ?" "No difference."

"Always wound the same ?" Not always, because you may have a differentially wound motor or an accumulative motor."

"What is a differentially wound compound motor ?" "It is very simple if you only go down to the basis of the thing."

"By the bye, where does the induction motor come in ?" "That is an entirely different kind of a motor."

"How many different kinds are there that you have forgotten to tell me about ?" "I think that is about all."

"You don't make compound wound induction motors ?" "Oh no."

"Let us see, we were talking about—" "We were talking about a differentially wound and an accumulatively wound compound motor."

"Well," he says, "there is an awful lot about this thing that I didn't know about." And thus they go on. (Laughter)

Some of us have had experience with printers and a great many of us have had experience with street car operators. I am very sure some of the gentlemen here will bear me out in saying that we have to make the installation as simple as we can and follow the rule of the French woman who said, if she had more time she would write a shorter letter.

Mr. Higman : As a bye-stander viewing this matter outside of actual practice, I would say that the question which most concerns the central station manager is not what may be the best practice in large machine shops, but how best to meet the demands of small users of power. The question of power in a large factory is one of minor importance, amounting as Mr. Lozier tells us to only three or four per cent. of the total cost of the equipment. Nineteen-twentieths of our central stations in Canada generate only alternating currents and the question of how best to meet the demands of all services from one set of generating units is of first-class importance. What would you recommend ? A constant speed induction motor with mechanical regulation, or the more flexible direct current motor, and if the latter what is the best method of transformation ? Something along this line would be helpful to us all.

Mr. Toltz : I have been very much interested in the paper relating to the variable speed motor,read by Mr. Lozier, but to determine if such motor should be used on a tool, I would advise that every case in every shop should be studied by itself. Being a railroad man, I can speak only about railroad shops. There is no doubt that the variable speed D. C. motor has great advantages, but as most of the tools in a railroad repair shop are run to a constant speeds for the simple reason that each machine is assigned to a certain class of work, which it will do year in and year out,the A. C. constant speed motor is much preferred. To make clear this assertion, reference is made to tools like a tire lathe. Each important shop has from 4 to 8 of this kind of machine, but each one will turn a certain size of tire. For instance, a 96″ wheel lathe will turn tires from 86″ to 90″; a 42″ wheel lathe will turn the tender wheels, which are generally from 36″ to 40″ in diameter, and as each machine has a cone the speeds could be varied according to the softness of the metal which has to be turned. The same can be said of planers, slotters and shapers. There are, of course, tools for which variable speed of wide range should be provided. Reference is made to boring mills, especially on which tires of 86″ in diameter are bored and at the same time the hub of the centre of a driving wheel has to be bored out; this hub being about the diameter of 10″ to 14″. In laying out tools for the C. P. R. shop at Montreal, which will have an aggregate horse power of 5,400, most of the tools were grouped and all heavy tools, especially under the service cranes, are driven by individual motors. Out of this whole aggregate of 5,400 horse power,tools to the amount of only 150 horse power will be driven by variable speed motors. All group and individual tools will have the A. C. constant speed motor, while for the variable speed tools the D. C. motors of special type will be applied. This, of course, necessitates a motor generator set to convert the A. C. current into D. C. current. In regard to the speed which a tool should run to work a certain kind of metal, the operator of the tool should not be the one to determine such speeds. Herein I disagree with Mr. Lozier and Mr. Cooper. Each well regulated shop should have a shop system whereby the operator of the tool simply has to follow instructions which are given him on the card describing the piece of work. He will find on this card which cone or back gear he has to use if the tool is run by a constant speed motor either individually or in group, or in case it is driven by the variable speed D.C. motor, the notch in the controller to be used is recorded. Such shop system at the same time is a check on the workmen because the speed and the cut being known the time can be easily computed in which such work should be done. I admit that their is a difference between a railroad repair shop and a manufacturing shop because in the latter, a hundred different kinds of work may be done on one kind of machine, but such is not the case in the railroad shop and I am simply speaking from that standpoint.

The President called for the reports of any committees which had not reported on Wednesday.

Mr. A. A. Wright presented the report of the Committee on Statistics, and said : Just before commencing to read this report I may say that compiling statistics is rather a difficult task I can assure you ; when you have once tackled the problem you will find how difficult it is. We found it was almost impossible to get the information which we wanted from the parties who possessed it. They seemed to think they had enough to do to mind their own business and in fact they frequently told us that ; the consequence was we took it for granted that they meant we were not minding ours and we had to drop them and proceed in the best manner that we could. However, such information as we were able to glean we are glad to present to you in this concise form.

REPORT OF COMMITTEE ON STATISTICS.

To the Canadian Electrical Association :

Your committee on Data appointed at the last annual convention of this Association beg leave to present the following report :

1st. We find it very difficult to get any very reliable information concerning the electrical industries in Canada in their earliest growth.

We can however confidently lay the following limited information before you, fully believing that it will be found to be fairly reliable on those points that your committee have taken up.

You will please bear in mind that this statement does not include the large number of isolated plants, i. e. private lights where commercial enterprises have electrical plants of their own doing their own lighting.

Your Committee found it impossible to get any reliable information concerning these and consequently the number of arc and incandescent lights given in the accompanying table should be increased to a very considerable extent but just what percentage of increase should be added we do not care to undertake to say and consequently we have confined ourselves to those companies which are doing business under a license from the government.

Provinces.	1898				1899				1900				1901				1902			
	No. of Companies	No. of Lamps		Registration Fees Paid.	No. of Companies.	No. of Lamps.		Registration Fees Paid.	No. of Companies.	No. of Lamps.		Registration Fees Paid.	No of Companies.	No. of Lamps.		Registration Fees Paid.	No. of Companies.	No. of Lamps.		Registration Fees Paid.
		Arcs.	Incan-desc't.			Arcs.	Incan-desc't.			Arcs.	Incan-desc't.			Arcs.	Incan-desc't.			Arcs.	Incan-desc't.	
Ontario	165	6,185	238,191	$2,295	172	6,297	271,220	$2,495	187	6,577	334,153	$2,760	196	6,830	384,496	$2,905	198	7,230	457 295	$3.022
Quebec	40	2,609	131,101	625	44	3,060	163 014	720	49	3,096	214,362	777	50	4,118	270,120	782	52	3 605	340,120	850
Nova Scotia	20	450	28,697	310	23	401	33,109	320	23	372	38,725	350	21	373	39.516	315	24	409	46,475	375
New Brunswick	9	411	13,500	150	10	459	15,101	175	11	657	15.747	200	11	691	18,131	185	11	699	21.685	185
Manitoba	6	162	13,800	120	6	155	13,190	120	6	177	21,359	100	6	22	19.250	275	6	43	26,635	290
British Columbia	11	457	28,866	200	12	477	39 578	210	13	587	46,783	250	14	643	68,763	275	16	770	85,435	290
Prince Edward Island	3	90	4 750	45	3	87	6,325	60	3	87	6, 30	60	3	92	9,526	60	3	87	11,330	60
The Territories	5	25	4,689	65	5	26	5,105	80	5	34	5,700	95	5	31	5,785		5	31	6,051	
Totals	259	10 389	463 615	3,810	275	10,962	546 642	4,170	297	11.587	683 250	4,592	306	12,800	815,676	4.797	315	12 874	995.056	507.500

From this table we are enabled to glean the following information :—

That the number of companies doing business in electricity in connection with lighting has increased from 259 in 1898 to 315 in 1902.

The number of arc lights in use has increased during the same period from 10.389 to 12.874, while the number of incandescent lights have grown during the same length of time from 463,615 to 995,056 or more than doubled in number in 4 years.

In the matter of incandescent lighting it will be noticed that every province has made substantial and most creditable progress and we have no doubt that when the present year shall have closed the progress will be found to be equally great.

Your committee would also have been pleased, if they had been able, to give you some reliable information with regard to the growth of enclosed arc lighting, but the means of obtaining this information has been so limited that we have been obliged to omit this subject.

We might also mention that of the large Canadian cities in which electric lighting is carried on Montreal stands first with reference to the number of its lights.

Montreal having	2,474	Arc Lights	and	184,978	Incan.
Toronto comes next with	1,672	"	"	100,000	"
Ottawa has	650	"	"	93,207	"
Hamilton has	600	"	"	32,400	"
While Quebec has	500	"	"	40,000	"

One point to which we would respectfully draw your attention is the fact that in the Province of Ontario at last municipal ownership seems to have taken a pretty firm hold, no less than 44 towns owning their electrical systems as you will see by the following list. It is not our duty to enquire into the desirability or undesirability of municipalities going into the business of furnishing light and power. We merely have to do with the presenting of such facts as we can glean on this subject and allow others to undertake the discussion of results.

The following places in Ontario have municipally managed electrical plants to which are attached in most cases the year in which they assumed control.

1. Almonte
2. Acton
3. Alexandria 1895
4. Aylmer 1900
5. Barrie 1899
6. Brockville 1900
7. Beeton
8. Bracebridge 1894
9. Blenheim
10. Bothwell
11. Campbellford 1889
12. Chatham 1898
13. Collingwood 1899
14. Dundalk
15. Dresden
16. Fort William 1897
17. Fort Francis
18. Goderich 1889
19. Guelph 1903
20. Hespeler
21. Huntsville 1897
22. Iroquois 1901
23. Kincardine 1894
24. Mitchell 1888
25. Markham
26. Morrisburgh 1901
27. Niagara
28. Niagara Falls 1889
29. Newmarket 1896
30. Orillia 1887, 1901
31. Oakville
32. Parry Sound 1901
33. Paris 1901
34. Picton 1890
35. Prescott 1899
36. Port Arthur
37. Palmerston
38. St. Marys 1896
39. Sudbury 1895
40. Toronto Junction 1891
41. Trenton 1895
42. Thorold
43. Weston
44. Woodstock

Of the other provinces and territories we have not been able to glean sufficiently reliable information to guarantee us in tabulating them as we have Ontario.

It is also pertinent to add that the towns of Perth, Listowel, Ingersoll, Wiarton, Renfrew and others are at present arranging to purchase the plants in their respective localities.

A. A. Wright, Chairman
K. B. Thornton
D. R. Street

Mr. Lozier moved that the report be accepted, with thanks for the very careful manner in which it had been prepared.

Mr. Higman : Before the motion is adopted I would like to correct the impression that these companies are doing business under a "license" from the Government. That statement might convey a wrong impression. The companies are doing business under charters obtained from the legislatures and letters patent, and the Department could not interfere with them. The Inspection Act requires that companies shall register, and pay a registration fee to help meet the expenses under the Act. Registration is also necessary for purposes of statistics; but it is in no sense a license.

Mr. A. A. Wright : I cannot understand the honorable gentleman when he says they are not licensed. What do I pay this money for ? I think I pay every year for a license. I notice that in the year 1902 the companies doing business in the Dominion of Canada paid into the Government $5,075. Now what did they pay that money for? I have always understood that we were paying that money for a license. We send our money down to the Government and we get a receipt back which I have always considered was a license.

You can call it whatever you like, I know we pay the money. If we didn't pay that money I suppose they would want to know why this is thusly.

Mr. Higman : The registration fee is part of the sum necessary for carrying on the work of inspection. The inspection fees for meters alone would not be sufficient. We had expensive Standards to install and other work to do and it was thought that a small registration fee levied on every company doing business would help the work along. By means of registration we have a complete list of all companies doing business. The word license, if used, is incorrectly used.

Mr. A. A. Wright : (W)right may be wrong, but I am under the impression that when we get our printed notices from the Collector of Inland Revenue that "license" is the identical word used. This I may be mistaken in ; I will look that up.

Mr. Higman : My friend is always (W)right.

Mr. Saxby : I believe that during last year the Government in connection with a great many of the smaller plants reduced the fee from $25 to $10. I know where we paid $25, only last July we only had to pay $10. They have made a reduction down to a certain number of lights.

Mr. Higman : The policy of the Government in this respect is that as the fees for the inspection of meters increase the registration fees will be decreased. At present the fee for all companies having an installation of five hundred incandescent lamps and under is five dollars ($5.00) a year, all companies having an installation of over five hundred and not exceeding two thousand incandescent lamps, a fee of ten dollars ($10.00) a year, and all companies having an installation in excess of two thousand incandescent lamps, a fee of twenty-five dollars ($25.00) a year.

The President : This report will be received and adopted. I understand the committee to select the standing committees is ready to present an interim report.

Mr. Yule presented the interim report as follows :

REPORT OF STRIKING COMMITTEE.

TORONTO, June 11th, 1903.

B. F. Reesor, Esq., President C.E.A.

"The undersigned appointed by you as a Striking Committee beg to call your attention to article 19 of the new constitution now in force which differs somewhat from the former constitution as regards special committees.

(a) You will find that the general meeting must first decide by resolution what committees are necessary or desired for the coming year.

(b) That the chairman must then appoint a committee of five active members to strike such committees."

Respectfully submitted,
JNO. YULE.

The President : That being so it will be necessary to pass a resolution at this stage to determine what committees you wish appointed. The committees appointed last year were : Legislation for Ontario and Quebec ; Statistics ; Arc Light Rating ; Standardization of Accounts ; and to confer with the Fire Underwriters. If you do not require that many committees it would be proper now to pass a resolution.

Mr. Dion : I will move the appointment of a Committee on Legislation for Ontario and for Quebec and a Committee on Statistics. My intention was to leave out the Committee on Statistics as well as the other committees which are not now doing any active work, but from the report which has just been read I find that for the first time in ten years the Committee on Statistics has given signs of life ; therefore I will give them another chance.

Mr. A. A. Wright : Hear ! Hear !

Mr. Dion : I think those three committees constitute about all that is necessary at present. Should any special matter come up during this meeting to make it advisable to elect other special committees, we can do so ; but at the present time I fail to see any necessity for any of the other committees which have remained on from year to year and are not doing any active work.

Mr. Yule : I second the motion.

The President put the motion, which, on a vote being taken was declared carried.

The President named Messrs. Dean, Williams, Holman, Henderson and Fisk as a select committee of five to strike the standing committees, and stated that it would be necessary for them to report at the next session.

Mr. Yule moved, seconded by Mr. Hunt, that the report of the Committee on Legislation for Ontario be now taken up.

Mr. Yule : I suppose the only feature in this report we have to discuss this morning is one I called attention to yesterday, that owing to the amount of work to be done and the help that had to be engaged the committee find themselves considerably short of funds. The amount of the accounts that we incurred from year to year, from 1898 until now, has looked large. We have found it necessary to engage counsel and solicitors for any help we required. The agitation to get protection for the companies was started in 1897 and continued until 1899, when we succeeded in getting passed through the Legislature what is now generally known as the Conmee Bill. There was quite a large expense, but each year since that time we have been more or less put to the necessity of defending and keeping these amendments on the Statute. To do that cost money. In the first part of the campaign the companies contributed fairly liberally and we were also helped, I am very glad to say, by two manufacturing firms, the Packard Company, of St. Catherines, and the then Royal Electric Company, of Montreal. They helped us out of our difficulties in 1899. Since that time we have managed to go along very nicely and pay our way, but this year the fight was so strong and vigorous we had scarcely time to breathe and it may seem to you peculiar when I tell you lawyers were scarce this year ; we could not get the lawyers we wanted ; there were investigations going on in Ontario and there were railway bills in Ottawa, and a great many different things that took the best talent and the talent we wanted to secure ; the result was we had to divide up the work and secure men for limited periods to do the work that we thought necessary. Our accounts are rather large ; they amount to $1,609.85. Our excuse for incurring those accounts is that we have been successful. We have accomplished what we set out to accomplish and we have done good work for the companies in this province. We have saved for them, I am safe in saying, millions of dallars. Another thing that has weakened us, gentlemen, is that the companies are gradually going over to the municipalities ; they are being gradually bought out ; we are being weakened in that way ; some of our strongest supporters have gone over, Berlin, Brockville, Owen Sound, Guelph and Kingston, etc. We managed to collect this year something like $855.76 and have further promises ; the committee have been hard at work since we met here trying to get extra subscriptions from those who have already contributed and from those who have not contributed, and have met with fairly good success, but are still short about $500. The committee have looked into the finances of the Association and seeing that all the members, especially the men who represent companies, have been largely benefitted and protected by our work, consider that they ought to vote a sum of $300 from the funds of the Association to help us out. You will see if we are going to come to trouble now the whole thing goes to pieces and the companies would be left to individually look after their own interests. That might be a better method ; it might be better to change over in that way, it is for this meeting to decide, or to go on in the way we have been going. I would also call your attention to this, that the members of the committee have paid their own expenses. I have been in Toronto three or four days a week from one month to two months each year since 1898, and it never cost this Association or any company a cent ; my expenses were not taken out of the contributions made by the companies, so that any subscriptions paid were devoted entirely to the legitimate expenses, legal help, counsel and assistance of that kind. There was no member of the committee who received a single cent towards his expenses and under those conditions I think it is only fair, as we have got into this difficulty now, that the Association at large should come to our aid, and to bring out the feeling of the meeting I would move that the Association vote $300 towards liquidating the accounts of the Legislation Committee of Ontario.

Mr. Hunt : I have been on this Legislative Committee for a year or two and I know something about the way the moneys have been expended, and there is nothing secret about it. If any gentleman present who has subscribed wishes to come forward after the meeting is over and look over the accounts he is quite at liberty to do so, but I want to impress upon you the fact, as Mr. Yule has said, there is not one cent of the personal expense of any member of that committee that has been taken out of the funds subscribed for legislation. I don't know that there is any particular praise due to us for it, as we simply were doing our duty and and in protecting our own interests we were protecting yours as well. I think it is quite within our rights, and in fact I think this meeting should vote some funds towards helping to pay the legislation accounts which are now due, and I think this Association would do well to give this $300 for which Mr. Yule has asked. I have pleasure in seconding the motion.

Mr. A. A. Wright : I would like to say one word in support of this resolution. There is no doubt that this Legislation Committee have done exceedingly good work during the past. I believe everything my friend Mr. Yule has said, that they must hve saved the companies in this province at least a million of dollars, if not more, and I do not see anything to hinder this Association as a whole doing something in aid of this work which has been undertaken, and, as our friend Mr. Yule has said, carried to a successful issue. I think there one thing that the last speaker rather overlooked, and I do not think he will blame me or find fault with me when I call his attention to it ; I don't think he will object to it ; he said there was no reason why any one who had given to this fund should not come forward and see that the amount they had given was actually there and accounted for. I don't see that there can be any reason why those who have not given cannot come forward and see the amounts which they have given in support of this good work. It seems to me that there are a large number of companies doing business in this country of ours that one of these days, if this Conmee Bill is thrown out, will waken up some fine morning and find their stock which now is valued at $7,000 will be worthless. I do not see why, under the existing circumstances, those who have given nothing for the advantages gained except their membership fee should not contribute a small proportion of those membership fees out of the money we have in our treasury towards this good work.

The President put the motion, which, on a vote having been taken, was declared carried.

The President called upon Mr. G. U. G. Holman, of Quebec, to read his paper on "Some Points Relating to Submarine Power Cables."

Mr. Holman : With the consent of the President and the gentlemen present, I will ask Mr. A. C. Read, of the Canadian Electric Light Company, to read this paper for me.

Mr. Read : The paper, which is only a short one, is to bring forward the work of submarine cables which we have had some experience in, and if there are others contemplating this kind of work it will bring out a few points that you would like to hear about. The paper as read is printed elsewhere.

Mr. Holman : With reference to the type of cable we would use, as to whether we would use the paper rather than the rubber, I might say that owing to the indentations which we discovered by soundings in the bottom or bed of the river, as well as the supposed mechanical movement of that cable by the tide flow of the water, we thought it would be very injudicious to use a lead covered cable using paper as the insulation because if a break in the lead covered cable would ensue the cable would be absolutely worthless.

Mr. Smith : Do I understand Mr. Holman to say it is a lead cable.

Mr. Holman : There is no lead in the cable that we are actually using. The paper covered lead cable would have been less expensive, first cost, than a rubber covered cable armored with spirally wound heavy steel galvanized wire.

Mr. Read : Mr. Holman was speaking about the paper covered cable, and if a break occurring that way, the water would get in and spoil it. With the rubber covered cable we had a break and the water got in; we commenced to cut back, but we found that was useless, so we went to work and joined the cable up as well as we could and we found the water that did get in had no effect at all. We thought that perhaps if there was any heat in the conductor, and any of that water was there still, it would move up towards the shore end and disperse gradually.

Mr. Lambe : Are we to understand from Mr. Holman then that he would consider it advisable to use lead for the work?

Mr. Holman : Inadvisable to use lead with a rubber covered cable; in other words, it is an extra precaution which our experience has shown not worthy of being paid for.

Mr. Lambe : It would be interesting to learn how you protect the ends? What sort of cable house you use?

Mr. Holman : We have laid that cable into the shore and brought the cable up to the best natural point in the shore, and fortunately we were very favorably placed with regard to a feature that happened to be on both sides of the river, but the worst ice condition which we at the time considered would be possible was on the south shore, the Levis shore, and there is where we took our extra precautions in bringing in the shore end ; we brought it up in a space between two contiguous or adjacent walls, or a dock-like space, and in through the crib work, removing some of the stones for that purpose, and anchored it by means of small three quarter inch chains tied around the cable and wrapped around the crib work and then bringing the cable up through and attaching our bell and we brought the bell up inside of a little cable box. You cannot get the cable box too large ; that is my experience. The first ones we had were, I think, altogether too small. It is advisable to have switches between the terminal ends of each of the wires brought out from the bell and lightning arresters.

Mr. Lambe : What do you say as to the cable versus aerial lines, if you can get up an aerial line without having the strands too large?

Mr. Holman : By all means do it.

Mr. Black : I would like to ask when this cable is taken up for repairs if it shows much mechanical wear.

Mr. Holman : It apparently shows no wear. There were several places where the outer steel covering was apparently rubbed, but we noticed the same thing at places where it could not have rubbed, showing that it probably was caused during shipment. The cable No. 1 was shipped to us coiled on a flat car in the form of the figure "8" and the movement up and down between the sides of the posts on a flat car would be more likely to cause the slight disappearance of a portion of the outer covering on some of the steel wires.

Mr. Black : How long has it been down?

Mr. Holman : It was placed in the river in December, 1901, and we had our breakdown in October, 1902. As long as the cable had been down three months from the beginning, in other words, in the month of February or March, it was deemed by myself and Mr. L. R. Clarke, of the Safety Insulated Wire and Cable Company, of New York, that any cable standing for three months under those conditions was a sound cable electrically. But, as you notice in the paper, it was a mistake in, if you might call it, mechanical design to place little wires that might be broken and did break and cause the things we have seen, the erosion or deterioration of the contiguous insulations.

Mr. Gossler : I would like to ask if it is in order at some later time in this convention to re-open the discussion on Mr. Lozier's paper. The paper is well worthy of more discussion than it was given this morning and I know in some instances the remarks were merely preliminary and if it is in order I would like to have a time appointed when this paper could receive more consideration. I notice later on there is a paper which I have not had an opportunity to read, on "Single phase alternating motors, as a means of Increasing Station Earnings." Would it be in order to discuss Mr. Lozier's paper after that or in connection with that paper ? Certainly much of the information we are to get from the papers presented before the Association is expected to be brought out in discussion and I for one would be very sorry to see this paper on variable speed motors passed over with so little discussion. There are a great many here competent to speak on this subject, both men familiar with machine design and also operating men who desire to increase their output.

The President : I think opportunity probably will be given this afternoon sometime. At any rate it is quite in order to have the discussion on the paper re-opened at some future time. I do not know at what time it would be most suitable.

Mr. Higman : We might take up Mr. Gossler's suggestion and bring it in under the discussion on this other paper.

Mr. Dion : If the discussion of Mr. Holman's paper is finished we have at least half an hour or more to dispose of before we adjourn. It was intended to take up the Question Box, but this is as broad as it is long. You take this time up with something else and bring in the Question Box later on. We could have this discussion on Mr. Lozier's paper or in connection with the other paper on motors which is to be read. Perhaps we had better take it up now, as the gentlemen who intend to take part in the discussion may not be here later.

Mr. Hunt : Is Mr. Layman here to read his paper ? It might be taken up at once.

The President : Mr. Russell, who is to read Mr. Layman's paper, says he did not expect this paper to come up out of the regular order, and he is not quite prepared.

Mr. Dion moved, seconded by Mr. Gossler, that the discussion on Mr. Lozier's paper be now re-opened. Carried.

Mr Gossler : Mr. Chairman, to open the discussion, I will again emphasize the point mentioned in Mr. Lozier's paper, of working every machine tool in a shop at its highest output. I will not undertake to discuss this paper from a machine design standpoint, but from the operating point of view. Working every machine in a shop at its highest output, of course, gives a more constant day load which we are all after, and it will enable us to extend the idea of selling power on a limited basis which permits of more over-selling of power than any other system that is within my knowledge. We have connected with the system with which I am associated, between seven and ten thousand h. p. which is served on the limited basis; that is, we have seven to ten thousand h. p. which from the 15th September to the 15th March of each year, is discontinued at 4 o'clock and is not used again until 7 o'clock p. m., that is, none of that seven thousand to ten thousand h. p. is used from 4 to 7 o'clock between the 15th September and 15 March of each year. Of course, it is obvious what is to be gained by that; it permits of the overselling of power for lighting, and also permits of quoting prices for power which cannot be competed with by steam. While the power service is limited, the number of factory hours per annum is not reduced ; that is gotten around by reducing the time taken for luncheon and also by starting a half or quarter of an hour earlier in the winter. By this means, it is possible to get a more constant day load for the station, and by working the machines at their highest output continually, will permit of the extension of this idea of overselling power. That is one of the points I wanted to bring out in connection with this matter.

Mr. Holman : How does the shop workman take the innovation of the use of tools that will get out more than the regulation amount of work ?

Mr. Lozier : The shop workman is a peculiar kind of animal, he is worse than a horse ; he shies and backs and wants to be fed and you have to handle him very carefully, but it is being done very successfully and it is being done in a very practical manner. I don't know perhaps of a better illustration of that than right here, if you want to have a pitcher of ice water in a hurry, you give the bell boy an extra quarter of a dollar and he hustles it to you. The system that is being most commonly used in the shops is to tip the workman. We don't say anything about piece work or contract work or anything about any of these new fangled works, we just go to a man and say, look here Jack, here is a piece of machiney to be machined and the way to machine is in just this sort of a way ; if you want a tool don't go and grind it yourself, you push the button alongside of your machine, there is an indicator over there, a boy come up and he goes to the tool room and he gets the tool that the engineering foreman has marked on the method card to be used ; if the tool gets dull send and get another. This work can be machined in just a certain length of time ; it takes about fifteen minutes for crane service, it takes about twenty minuter to handle the work, to set it, and about ten minutes to get ready and we have got a cylinder, the surface of which has got to be machined, and the area to be travelled by the tool at a certain rate with a certain feed is so long, and this tool can run at a certain cutting speed ; this thing is all figured out for you ; you don't have to worry about it. If anything goes wrong drop your tool or adjust it, but that surface, theoretically can be covered in a certain length of time at a certain cutting rate. Go ahead and see if you can't do that. If you do we will give you half a dollar as a tip.

"These bonuses run about seventy-five cents a day and any workman can make seventy-five cents a day as a tip in addition to his pay, or if he does better than that time he gets more." Jack says, "that tool is no good." "Never mind, you don't have to worry about that, we will take the responsibility for that." "I never set my work that way." "You try it that way." "It can't be done in that space of time." "You go ahead and try it." "I don't like this business particularly ; I am accustomed to doing things my own way." Then we stand off to one side for a minute and bring in the speed boss ; he takes hold of the work and he gets it through in about 80 per cent. of the time that is allowed Jack to do the work. The man working on the lathe, the fellow on the shaper right back of him and the planer hand, is giving Jack the laugh, and Jack gets down to business and starts in and makes his bonus. When we start, we pick out a pretty good man.

Mr. Saxby : A great deal of what you say is practically true, but there is a very great deal of difference in castings, some are harder and some are softer, and some not annealed very well and I notice some men have better luck with a piece of casting than others ; one man could work up soft castings very successfully and another man hard castings, but put the same two men on different grades of work and they are not equal to it.

Mr. Lozier : I think probably the answer to that proposition lies in two things. I am not very much of a shop man although I had my turn at it, but I think probably some of the gentlemen here can answer that question better than I. There is only one point I would like to bring up and that is this—I gather this from hearing our own shop people talk—it has been the custom in the past to make the patterns pretty close so that you don't have much metal to take off. That system is being abandoned to this extent, that it was found that most of the tools were cutting the scale rather than the metal itself and that the greatest variation was found to be between the different degrees of scale, and we are adopting the practice of being more generous in our allowances and cutting underneath the scale with the tool. Now if that isn't the trouble I believe it is time to get after the foundry and see what the trouble is there if there is a great variation in the quality of the castings.

Mr. Thomson : Have you ever really tried tipping the workman ?

Mr. Lozier : Yes, that method is being adopted almost universally and being very successfully applied.

Mr. Thomson : What is the nationality of your workmen ?

Mr. Lozier : We have all kinds of workmen.

Mr. Thomson : I don't think the ordinary working mechanic would accept the tip. (Laughter)

A voice : Well the bonus.

Mr. Scott : The remarks about the tipping of the workmen or what in general covers the same method, the premium system, is one which is interesting in itself and I think it calls attention to a fact in connection with the electrical work, that the electric motor in the machine shop is not only superseding some other form of drive and can not only do its work better than it was done by some other means before, but the motor can do it cheaper, and it is also leading to changes in the construction of the machines themselves ; changes in the tool steel ; changes in the method of work ; changes in the method of paying and even in shop organization and system. With the works with which I am connected, though I am not connected directly with the manufacturing department, the premium system is pretty generally in vogue. That system in its simplest form might be illustrated in this way : Suppose it is found that a piece of work could be done normally in ten hours. That, then, may be taken as a basis. When workmen are hired they are expected to do that much ; if they do not do that much they are paid their day's wage anyhow. If they do that much, well and good. If they do more then comes in the bonus or premium. If a man can do his ten hours work in eight hours he received nine hours pay ; if he can do it in six hours he will receive eight hours pay for that six hours. In this way the superior workmen has the advantage of making a substantial increase in his wages, while the company gets a much greater out-put from its tools and its factory. This method in one form or another is in actual and successful work in quite a number of places. One point which Mr. Lozier brought out very well in his paper is the real insignificance of the cost of the power itself. I do not recall to a nicety the figures which were published sometime ago with regard to the locomotive works at Philadelphia—these works are very extensive, turning out on the average several locomotives a day—it was found there that of the total cost of production, the cost of power, including the interest on the investments in power plants, the fuel, repairs and all that kind of thing, amounted to in the neighborhood of three per cent. or four per cent. of the total cost. If by even doubling the cost of the power it would be possible to increase the out-put ten per cent. or to make the labor five or ten per cent. more efficient. It would evidently be economy to do so. Coming more to the technical details, Mr. Lozier has taken up the matter of range in speed in motors and has given certain ranges which may in some cases be necessary. He mentions even a range of one to one hundred. While such ranges may occur I take it that they will be the rare exception ; in most classes of work the range required even for variable speed work—will be much less than that, and that even where changes in speed are necessary, sometimes a high speed, sometimes a low speed, those changes need not come rapidly. The cases will be very exceptional when it is necessary to run through the whole range of speeds on one piece of work or in a very short time. Where the changes are to be made less seldom, then the mechanical methods which Mr. Lozier has suggested may be used ; that is, a change gear or a number of change gears or a cone pulley which would give several speeds by shifting the belt, could be used with a motor which will have a less range of speed, using a moderate range of speed variation with each of the mechanical adjustments. In taking up any new plan the fact must be remembered, as was brought out in discussion, that scarcely ever two kinds of work are alike and the question ought to be taken up in a good broad way. If every machine is going to need speed variation over a wide range, we have one problem. If in a large majority of cases each machine is going to do approximately the same work continuously, turning the same kind of shaft for example, then speed variations to the fine degrees are not so essential, and a method which would allow a selection of either one of several speeds would be satisfactory, possibly one of the methods which has been used in the past employing change gear or cone pulley, by which a number of definite speeds can be obtained. By such means we may be able to cover a great many of the lines of work which are to be done in any specific shop. The problem, therefore, in taking up the question of equipment for a new shop or the re-equipment of an old one will be to determine what machines are to run at approximately constant speed, and could be driven by constant speed motors, or by group driving, which has numerous advantages, and how many machines require the greatest flexibility in motor speed. I take it that in very many kinds of work and in very many shops it will be found that a very considerable portion do not require any very radical change or altered methods of speed driving from those found in a good many cases now. There are machine shops that have a variety of work, which are driven by constant speed motors and have mechanical means of speed change, and, as pointed out in the paper, do not have all the desirable and flexible characteristics that are possessed by the direct current motor in its facility for speed control, yet they are accomplishing the work in a highly satisfactory manner. When we come from the actual conditions in the machine shop to the electric systems we find about as great a variety as there are requirements in the shop itself. I was very much interested not long ago to look through a report which has been made by Dodge & Day, a new firm of young men in Philadelphia, which has given itself the the very characteristic title of "Modernizing Engineers." They had made the study of a certain machine shop ; they had outlined the different classes of machines and the requirements ; what would need constant speed ; what would need variable speed over a certain range ; what would need variable speed over a wider range. They had then taken up the different electric systems : Here is the alternating current system with constant speed induction motor ; here is the Reeves pulley and Evans friction cone, and other methods of getting various speeds from one speed over different ranges ; here are direct current motors with variable field, with multi-voltage control and another system with what in general we might term as a combination of the two, that in which certain steps of voltage—maybe two voltages—are employed, and in addition to this the variable field. They had classified all this and made a study of these different methods. Then they returned to the machine shop which they had in hand and selected the general system, which in that specific case was a direct current system, which they found to be best and then took that particular system and proceeded to assign the motors to the various classes of work. Although I have been giving some attention to this machine shop problem for some time from an electrical standpoint, I must confess it was a revelation to see how much there was in it when both ends of the problem were thus presented together in a broad comprehensive way. The general methods which Mr. Lozier has pointed out possess many characteristics of excellence, but I think we can take this as a general statement, viz, that when we rely on one part of the system for doing the more difficult things we must do it at some sacrifice both in cost and in simplicity and general effectiveness or efficiency of the working. For instance, if we throw variable speed changing into the mechanical operation of the equipment we will find we have more mechanical complication than we would otherwise have. If on the other hand we put it into the electrical apparatus it is natural to suppose that when the mechanical engineer gives up the problem he has been working on for a good while, and has not solved it yet in a fully satisfactory way, and the electrician takes it up, we must expect the electrical machinery must be made at some sacrifice in its simplicity or in its cost ; it will probably cost more ; you will have to pay for this extra advantage which you cannot have obtained in other ways. We find, then, that there are various different arrangements of the electric system, one with which I am particularly familiar is that in which the direct current motor having a fairly wide variation through changes in its field strength is supplied with two voltages such as those in the Edison direct current system, 110 and 220 volts. This does not give the same number of difference of speed by shifting from one circuit to another that is obtained in the more complete multivoltage system in which there are twice that many voltages available, more or less, but it has certain advantages in the way of simpler circuits and simpler generating equipment and is found to cover quite a wide range of usefulness. There are a number of plants in which both direct and alternating current motors are used, some steam-driven for factories as well as water power plants with long distance transmission where the alternating current is supplied, and it is a choice of either using it immediately, or employing some type of converting apparatus to get it into direct current. There the chief object is to use in the form of alternating current all the available power that can be used to save expense. Where the desirability of using direct current for the variable speed is such as to justify the introduction of converting devices, well and good. Not only is this true in plants which have alternating current plants to begin with as transmission plants, but I know of a number of isolated plants which have been put in where it is a choice of making the direct current the one and only thing or putting in an alternating plant and then adding a rotary converter for that portion of the power which is needed for variable speed and direct current control. For example, in a certain rubber mill where the service was deemed to be very hard and the simplicity of the alternating current induction motor appealed to the engineer who was selecting the apparatus, it was determined to put in alternating generators and run the main part of the power, I think some 2000 h.p. more or less, by alternating current and then transform into direct current, the few hundred horse power they required for that type of work. I have been quite an advocate of the induction motor not because the induction motor is the only thing but because it is a good thing, and I am pleased to take that broader view which recognizes that each type of motor and each system has its own characteristics, and if it can show that it has on the whole the advantage over others for that particular place why it is undoubtedly the thing to use. But having been closely associated with the induction motor particularly, I am very pleased to note one thing this morning. A number of years ago—five or six years ago or longer—when an induction motor was mentioned, the advocates of the induction motor were put in the position of demonstrat- that the induction motor can start itself and will not burn out and will really do the business. This morning it is not some theoretical man who cares about the design of the motor or about something that goes on inside of it, but the men who have been using the motors who have said here in the discussion that of course the induction motor is the thing, it is the right thing to use if we can do so, and where we can't possibly use it then we will take the direct current motor. (Applause).

Mr. Holman : I should like to ask Mr. Lozier if they are adopting for d. c. work 250 volts as their standard in the Bullock Company ? The practice was tending at one time to be 500 volts. I should judge from his remarks they are putting it at 250.

Mr. Dion : I thought perhaps Mr. Lozier could answer two questions at the same time. I wanted to ask him another one. I was called away during the reading of his paper and I missed part of it and part of the discussion. I confess I am not familiar with the multi-voltage system of control of motors. I have read something about it, but my mind is not very clear on it at the present time. I wanted to ask him how he obtains his multivoltages ? How from a commercial circuit of a given voltage he obtains his different voltages.

Mr. Lozier : To answer Mr. Holman, we are adopting 240 and 250 as the standard voltage. We take that voltage in the so called Bullock System and split it up into 90 and 160 so that the sum of the two is 250, and in that way we have three voltages with three wires ; that gives you the standard three wire plan, cut-outs, switches and so forth. It makes one more wire to the wiring system so that it is the same as the common three-wire system, 120 volts on the side, except we split it up so as to get out of it all that there is in it. That is our text, we want to get all there is out of it ; we want to get a dollar out of a dollar. As concerns the balancer, they are really remarkably small ; the balancer goes something on the system of a life insurance company, who do not expect all of their policy holders are going to die at the same time. Nor do we expect all the motors will get on one side of the system. The motors balance themselves up. The more motors you have on the balancer the smaller the balance need be.

Mr. Hunt moved, seconded by Mr. Gossler, that a vote of thanks be given to Mr. Lozier and to Mr. Holman for the very valuable papers presented by them. Carried.

Mr. Dion : Since the motion was made with reference to the Standing Committees for next year I have had a consultation with a member of the Committee to confer with Underwriters and it has been deemed desirable to continue that committee. Not that there is any immediate need for it, but because need may arise at any moment and we wish to be in a position to call the committee together when this condition arises. I would move, therefore, seconded by Mr. Lozier, that we name a committee to confer with underwriters for the incoming year, in addition to the other committees. Carried.

At 12.40 o'clock p. m., convention adjourned.

AFTERNOON SESSION.

At 2 o'clock p.m. the President in the chair called the convention to order and asked for reports of committees.

Mr. Dion : The committee on striking the standing committees which you have appointed this morning beg to report and recommend the following for the various committees to be elected to-morrow:

Committee on Statistics—A. A. Wright, M. P., Chairman ; D. R. Street ; J. W. Purcell.

Committee to Confer with Underwriters—P. G. Gossler, Chairman ; A. A. Dion ; J. J. Wright ; G. U. C. Holman ; G. M. Wright.

Legislation Committee. For Ontario—Charles B. Hunt, Chairman ; A. A. Wright, M. P.; B. F. Reesor; A. A. Dion ; W. H. Breithaupt ; R. O. McCulloch ; J. J. Wright ; J. W. Purcell; with power to add to their number. For Quebec—E. A. Evans, Chairman ; J. McCarthy ; P. G. Gossler ; A. Sangster ; G. U. C. Holman ; with power to add to their number.

On motion the report was received.

Mr. Smith moved, seconded by Mr. Kammerer, the following resolution : This Association learns with deep regret of the serious and long continued illness of Mr. J.J. Wright, the First President of this Association, and begs to extend to him and his family an expression of its sympathy and best wishes for his speedy restoration to perfect health. Carried.

The following resolution was also adopted :

Mr. A. A. Wright : The members of the Canadian Electrical Association having learned with pleasure that it is apparently the intention of the Dominion Government to assist in a liberal and substantial manner the proposed Canadian Arctic Expedition under Capt. I. E. Bernier, it is therefore moved by A. A. Wright and seconded by H. O. Fisk :

"That in the interests of science, the Canadian Electrical Association, this day assembled in their Annual Convention, approve of the proposed government's assistance to Capt. Bernier, in aid of his purely Canadian Polar Expedition, and heartily recommends the project to public support, and it is furthur moved that Capt. I. E. Bernier be appointed to a life membership in this Association and the Secretary is hereby instructed to forward a copy of this resolution to the Right Hon. Sir Wilfrid Laurier, Premier of the Dominion, to the Hon. Mr. Prefontaine, Minister of Marine and Fisheries, and also to Capt. Bernier."

The President read a letter from the DeForest Wireless Telegraph Company extending an invitation to inspect the method of working the system in Toronto.

The President called upon Mr. W. A. Layman, St. Louis, to read his paper on "Single Phase Alternating Motors as a Means of Increasing Station Earnings."

Mr. Russell : Mr. Layman is unable to be with you and I will endeavor, with your permission, to present the paper, which is printed elsewhere.

The President : In order to facilitate matters I think it would be wise to have the other paper read now and leave the discussion until some other time, and we will have now a paper by Mr. J. W. Farley on "Transformers for High Voltage Transmission Lines," which is printed elsewhere.

The President : Our time is about up. I am sorry we have not time to discuss these papers considerably, but an opportunity will probably be available to-morrow.

The Secretary read a communication from The Cataract Power, Light & Traction Company, of Hamilton, extending an invitation to the Association to hold the next convention in the city of Hamilton, it being now five years since the Association had met there.

Mr. Hunt : These two papers that have just been read, I think, are among the most valuable papers to the majority of the members of the association that have been read. Can these papers be taken up to-morrow at 10 o'clock?

The President : I think the regular routine being first disposed of, that probably these papers can be taken up and discussed then.

At 3.30 o'clock p. m., on motion, the convention adjourned to Friday morning.

THIRD DAY.

At 10.30 o'clock a.m., the President called the Convention to order and said : Before we go on with the regular business on the programme Mr. Dion has one or two matters he would like to bring up.

Mr. Dion : Mr. Chairman and gentlemen, my position in this Association is that of a general handy man; I pick up the tail ends and bring business before the meeting that other people forget so as to keep things going. I mentioned a matter yesterday in connection with the committee which was appointed for the Standardization of Accounts. That committee was appointed two years ago and they went into the matter very thoroughly, as far as the means at their disposal would allow ; they consulted with a great many people and also obtained information from the National Electric Light Association which had threshed out that matter still more thoroughly ; they had been at it for years and they had adopted a plan which was recommended to its membership. This plan is very fully explained in a pamphlet which was published by that Association and which is entitled "Report of the Committee on Standard System of Accounts for Electric Lighting Companies." This was recommended to that Association and adopted by it. Now, after going into the matter, your committees were forced to the conclusion that they could not improve on that system ; that it met the needs of the companies in Cansda perfectly and just as much as anything else they could think of, and they made a report to this Association that it should adopt the system of the National Electric Light Association and recommend it to its members in Canada. Through want of time this report was not discussed last year ; it was merely laid on the table at the Quebec Convention. Mr. Street, of Ottawa, who was the Chairman of that committee, asked me to bring the matter up here to-day because he could not be present ; Mr. A. A. Wright, of Renfrew, was another member, but he was obliged to leave town this morning. Mr. Street's desire was that I should bring before you a resolution whereby this Association would recommend to its members the use of this system. It does not make it compulsory in any sense—of course we could not do that—but it simply gives the approval of the Association to the system. Now perhaps some of the members are not familiar with this matter, and you will hesitate to take any action on it on that account, but the matter has really been before the Association for two years and we should be in a position to deal with it. There may be no present need of any action of that kind but to those who are on the committee and have given the matter some attention it seemed desirable that some such system should receive the approval of the Association with the idea that in course of time it would lead to a uniform system of accounting on general lines by the different electric lighting companies in Canada. I would move, therefore, seconded by Mr. Williams, that the report of the Committee on Standardization of Accounts laid before the Annual Meeting of this Association be received and adopted and that the standard system of accounts for electric lighting companies adopted and recommended by the National Electric Light Association of the United States be adopted and recommended by the Canadian Electrical Association.

Mr. Evans : In connection with this motion I might mention that I have adopted that system for about fifteen months with most satisfactory results. It is the most satisfactory system I have ever found. If any members here would like to get a copy of the way I have my books ruled I would be very pleased to send a sample sheet on application. The President put the motion, which, on a vote having been taken, was declared carried.

Mr. Dion : Another matter which I desire to bring before you is that of the very generous contribution which was made to the funds of the Association some two years ago by Mr. Frederick Nicholls, on behalf of the Canadian General Electric Company. After the convention which was held in Ottawa, he presented the Association with the sum of $500 which was to be devoted to the purposes of the Association as the Executive Committee might decide. At a meeting of the Executive Committee held in Montreal it was decided that this fund or a portion of it should be devoted to procuring prizes for the best papers to be submitted at the annual meetings or for accounts of original investigations and things of that sort. A sub-committee was appointed to draft rules for awarding these prizes—I was on that committee—and the rules were drafted and sent back to the Executive Committee to be ratified as had been arranged. The Executive Committee did not meet for some time and when it did meet the matter was not taken up. The rules were never ratified. The result was that when the following meeting took place we did not feel at liberty to do anything in the matter because it was still pending. No definite action being taken by the Executive the matter came up again this year and we were in the same position. I took this view that not only were we not authorized to do anything, because the Executive has not finally ratified our rules, but that it would not be wise to grant prizes for papers where papers were contributed so largely by manufacturing companies. I did not think that the manufacturing companies in the preparation of papers were looking for any prizes or direct money rewards and that the idea of awarding prizes was to bring out papers from central station men and young men who would be thus encouraged to make investigations or to report their experiences. My purpose in bringing this before you this morning is to get an expression of opinion from the membership as to how this money had better be used in the interests of the Association, whether the prize idea is a good one and should be carried out or whether it should be dropped and something else adopted instead. A suggestion was made by a member that a considerable number of small prizes should be established to be given for the best answers to questions that would be asked through the "Question Box." Now, I have laid the matter before you. I would like for the direction or guidance of the Executive to hear the opinion of as many members as possible as to what they consider the best use we could put this fund to. I feel it is hardly fair to Mr. Nicholls and the Canadian General Company that this fund should lie there unproductive.

Mr. Hunt: I think that Mr. Dion has perhaps struck the proper key note for the distribution of this money which has been given by Mr. Nicholls. I do not think it is hardly right to give it to the best paper because some of these gentlemen who are closely connected with large companies have opportunities which no station man has. I think it had better be decided —to drop the present plan and put our energies into the question box in some way or other. My idea would be that we carry out the Question Box similar to the way it is done by the National Electric Light Association. The questions are sent in during the months, and Mr. Hartman, the Question Box Editor, sends out to every member of the Association a list of the questions that have been received and he also supplies a blank form, a copy of which I hold in my hand here, which is merely a form upon which the questions are to be answered; these go back to him and he collects and places them in tabulated form according to the answers that are given. They are then published in a book, a copy of which you have had laid before you at this convention, and certainly it is one of the most valuable collections they have in the National Electric Light Association, and nearly every member who was at the last meeting recognized the fact that there was more information contained in that book than they could get in a library, because it brought up the very difficulties we are having in our business frequently and the remedy for them. I think with Mr. Dion a certain proportion of this money should be set aside for the largest and best number of answers to the questions submitted during the year. It is a matter for the committee to deal with as to the best plan to adopt but I would move that $100 be set aside for prizes, say $50, $30 and $20, to the first, second and third best answers to questions during the year. In the other Association I believe they have a large amount of money available to pay for that sort of thing. But I think we will have to pick out two of the Executive Committee, when they are elected, to assist the Editor or Secretary in getting these matters in shape. I suppose it is sufficient now to vote the money and leave it to a committee to be appointed later on, if that meets with the consent of my seconder.

Mr. Demers: I agree with the gantlemen on my right. A Question Box is something which has always created an interest in a body. The National Association of the United States have questions and have given prizes and medals. Another thing, we must not leave out the education of the young. In my opinion young men who do not belong to the same body, and still at the same time fairly and honestly answer a question and do it correctly, such as we have had done in the States, should also be given a prize. If this money is going to be devoted to one body your body will never grow. You understand there are a great many men, hydraulic engineers, steam engineers and electrical engineers, that do not belong to this body, and they might be able by practical experience to answer questions which we could not. I would like to hear the expression of those present.

Mr. Hunt: The gentleman speaking thinks we exclude anybody from becoming members of this Association. I would be glad to have all these gentlemen join our Association.

Mr. Higman: That would be an inducement to them.

Mr. Gossler: It has been suggested that a great many of the questions will be answered very readily and there should be a portion of that money set aside for prizes and a certain fund to handle this matter during the year. I think that is a very important matter. To circulate questions and get answers and keep this thing going, which will be the most difficult part, some remuneration must be given to somebody to handle it.

Mr. Dion: I think this is a matter that can best be handled by the Executive. If the members here will express themselves so that the Executive will know what the feeling of the Association is, they can arrange the details perhaps better than we can arrange them here. My idea is, as Mr. Gossler has said, that in addition to prizes there should be a fund for expenses, postage, printing, and clerical work, and the Secretary will be in position to know just how much is required. Perhaps it will be sufficient and better for this Association to place on record a resolution to the effect that a Question Box editor should be named by the President or elected at the meeting and that it be a recommendation to the Executive to provide prizes and ways and means and leave the details to the Executive Committee for the coming year. A general resolution at this time would perhaps cover the ground and leave Executive free to act in the matter.

Mr. Hunt: I would move that this meeting approve of the idea of appointing a Question Box editor and that the appointment be left in the hands of the Executive Committee; and also that $100 be appropriated from Mr. Nicholls' generous fund towards prizes; and and that the expense of getting forms, postage, etc., be also deducted from this fund.

The Secretary: Let me suggest, I think the resolution that was passed governing the expenditure of that money restricted the amount that could be taken out of the fund each year to $75.

Mr. Dion: I think, Mr. Mortimer, that was done by the Executive Committee. It was done by the Executive Committee with regard to the awarding of prizes, and this was never confirmed, and a motion of this general meeting would override that, any way.

The President: To obviate any difficulty in future it would be perhaps better to have this resolution put in this way, that this resolution will supersede any previous motion.

Mr. Hunt: It would necessarily do so.

Mr. Dion: Supersede any action of the Executive regarding the awarding of prizes.

Mr. Deacon: I would second Mr. Hunt's motion.

The President put the motion, which, on a vote having been taken, was declared carried.

Mr. Hunt moved, duly seconded, that the selection of the place for holding the next convention and the election of officers be now taken up. Carried.

Mr. Hunt: I believe you have an invitation from the City of Hamilton to hold our next annual meeting in Hamilton, and it meets with my approval entirely, as we know Hamilton has made great strides in long distance transmission and also in electric power, railway matters and other things; also we are near Niagara Falls where large industries are now being built and completed, and I therefore move that the offer of Hamilton be accepted.

Mr. Smith seconded the motion.

Mr. Gossler: If I am not too late, on behalf of the electrical industries of Montreal, I would extend a cordial invitation to the Association to hold their next Convention at Montreal. I think that the interests around Montreal are of sufficient importance to warrant a trip there in themselves and we will do our utmost to give you a good time.

Mr. Dion and Mr. Evans seconded the motion.

Mr. Hunt: May I speak to my motion? I might say personally I am very favorable towards Montreal, but I do not think that it is entitled to a meeting next year. You will recollect that we went to Kingston and to Ottawa and then to Quebec during the last three years. This is the first meeting that has been held in the west for some time, and I think the west is entitled to one more year before we go east again.

Mr. Dion : In seconding this motion of Mr. Gossler's in favor of Montreal I wish to say that I do not do this because I do not wish to go to Hamilton. I think Hamilton is a good place and I would be very much pleased to attend a convention there, but I think there is some misunderstanding. People who live west of Toronto seem to consider that Toronto is the dividing line between the east and the west. Over in Ottawa we do not look at it in that light ; we think some places east of Toronto are in the west ; it is a mistake to think when you are going to Ottawa you are going in the east, because while you are going in an easterly direction you are only about the centre of the country. If you are going to say everything east of Toronto is the east it is going to be a little unfair to some of the places in the eastern end. We went to Montreal, from there to Hamilton, from there to Kingston and Ottawa, but if you will remember the circumstances under which we went to Kingston you will understand why we went to Ottawa afterwards ; from Ottawa we went to Quebec, and now we come back to Toronto, skipping Montreal. Hamilton got the convention after Montreal, so it would seem to me as a matter of getting its turn that Montreal is entitled to it. Apart from any other attractions, and they are considerable, there is a long transmission line from Shawinigan that I think a great many men in the west, who have no occasion to go to Montreal, would be glad to have an opportunity to see. I would not press this matter, I like to hear the feeling of the members, but I think Montreal is fairly entitled to it.

Mr. Higman : Frequently when I have been in the east, in New Brunswick and Nova Scotia, I have heard it said that the convention is too frequently held in the west and that the distances are so great that those down by the sea are not able to attend ; that would include Dalhousie, St. Johns, St. Stephen, Halifax and other places, and I agree with Mr. Dion and Mr. Gossler that we should have the Convention in Montreal next year.

The President : We have before us three invitations, the first one is from St. Louis, the second from Hamilton, and the third from Montreal.

Mr. Dion : There is no motion regarding St. Louis.

The President called for a standing vote on whether Hamilton or Montreal should be selected, and on a vote having been taken, Hamilton was selected as the place for holding the next Convention, twenty-five having voted in favor of Hamilton as against twenty-one in favor of Montreal.

The President : The next meeting place will be Hamilton. (Applause)

ELECTION OF OFFICERS.

The President appointed Messrs. Skidmore and Fisk as scrutineers.

Mr. Hunt : I have very great pleasure, in fact under the circumstances exceedingly great pleasure, in moving that Mr. J. J. Wright, one of our oldest members, who has been deterred by illness from being with us this time, be elected president for the ensuing year.

Mr. Smith : I have pleasure in seconding that, more especially as the Convention is to be in the west, we must have a strong and capable man in the chair.

There being no other nominations, Mr. J. J. Wright was declared elected unanimously to the office of President for the eusuing year. (Applause)

Mr. Dion : I have much pleasure in nominating Mr. K. B. Thornton, of Montreal, for the office of First Vice-President.

There being no other nominations Mr. Thornton was declared elected unanimously to the office of First Vice-President.

Mr. Smith nominated Mr. A. A. Wright, M. P., Renfrew, as Second Vice-president.

There being no other nominations Mr. Wright was declared elected unanimously to the office of Second Vice-President.

Mr. Smith nominated Mr. C. H. Mortimer as Secretary Treasurer.

There being no other nominations Mr. Mortimer was declared elected unanimously to the office of Secretary-Treasurer.

Mr. Smith : Last year I think we voted our efficient Secretary–Treasurer the magnificent sum of $125 for his services during the year. I would suggest this year we make it $150,—it is a growing time—a basis of fifty cents a day for every working day.

Mr. Thomson : I second that.

The President put the motion, which, on vote having been taken, was declared carried.

Executive Committee : Five members re-elected : Messrs. P. G. Gossler, A. A. Dion, John Yule, Gordon Henderson and A. B. Smith.

The President called for nominations for five new members to be elected to the Executive Committee.

Mr. Smith nominated J. W. Purcell, Walkerville.

Mr. Higman nominated H. O. Fisk, Peterboro.

Mr. Hunt nominated J. A. Kammerer, Toronto.

Mr. Thomson nominated C. B. Hunt, London.

Mr. Higman nominated B. F. Reesor, Lindsay.

Mr. Pratt nominated J. E. Skidmore, Cobourg.

Mr. Evans nominated C. K. Greene, Hamilton.

Mr. Dion nominated E. A. Evans, Quebec, and A. Sangster, Sherbrooke.

Mr. Evans : While the ballot is being counted I think we might with your permission move votes of thanks to the various committees and those who have done so much to entertain us. If you will therefore allow me, I take very great pleasure in moving a vote of thanks to the Canada Foundry Company, not only for the enjoyable ride they gave us to their works, but also for the pleasure we had in being allowed the opportunity of visiting those works. Personally, I am very much interested in that kind of work, and I was very much interested in seeing the large development which undoubtedly is taking place there and will continue to take place. I would move, therefore, that a hearty vote of thanks be tendered to the Canada Foundry Company and that the Secretary transmit the same.

Mr. Wyley : I second that. Carried with applause.

Mr. Dion : I beg to move, seconded by Mr. Williams, a cordial vote of thanks to the Canadian General Electric Company for providing the tally-ho drive for the members, and for other courtesies. Carried with applause.

The President declared, as a result of the ballot taken, the following five new members elected to the Executive Committee : Messrs. B. F. Reesor, C. K. Greene, C. B. Hunt, J. A. Kammerer, and H. O. Fisk.

Mr. Smith moved, seconded by Mr. Gossler, that the recommendation brought in by the Select Committee in regard to the standing committees be adopted. Carried.

Mr. Smith : I will ask, Mr. President, that you vacate the chair.

The President vacated the chair. Mr. C. B. Hunt in the chair.

Mr. Purcell : Mr. Chairman, and gentlemen, I wish to move a vote of thanks to the retiring President, Mr. Reesor, for his very efficient occupation of the chair and his arduous work not only in that chair but on the Executive Committee. He is one of the hard working men of the Association, and has, as long as I have been attending it, been very active in performing his duties in connection with that committee as well as the other things that are for the interest and good of the Association. I am not an orator, consequently I will leave it to some other member who might second my motion to enlarge on it a little.

Mr. Holman : I didn't understand particularly that it was necessary, in order to have the motion seconded, to enlarge upon the value of the past president to the Association, not only in the past year but in previous years, but as you desire a few words I have said them and I second the motion.

Mr. Hunt : Gentlemen, I can assure you it gives me great pleasure in putting this resolution before you.

I have known Mr. Reesor personally myself for a great number of years and a larger-hearted gentleman I have never met, and I think we have all found him the same way. (Here, here.) It gives me great pleasure to put this motion.

The motion was carried amid applause, followed by the singing of "For He's a Jolly Good Fellow" and the giving of three cheers and a tiger for Mr. Reesor.

Mr. Hunt : Mr. Reesor, I have pleasure in tendering you the hearty vote of thanks which has just been passed by this Association for your services during the past year, and we have voted you a jolly good fellow.

Mr. Reesor : Mr. Chairman and gentlemen, I feel very keenly the honor you have done me in voting this expression of your good feeling towards me ; I felt very keenly as well at being elected a year ago to the office of President of this Association ; I think it is an honor to whoever may occupy that chair ; and if I have done anything during the past year or years that I have belonged to the Association, I only feel I am doing the duty that I owe to the Association and to the company which I represent, and I do not think that I am entitled to all the praise that has been showered on me. I feel my inability many times and my weakness in getting up and saying anything. I am not a speaker, as you can all see with half an eye ; I am like the boy who said he was filled with feelings too full for utterance and other things. I must thank you again and thank the Association and the Executive for the way they have helped me carry out my duties while occupying the office of president. I again thank you for the honor you did me in passing this vote of thanks. (Applause).

Mr. Hunt left the chair, Mr. Reesor resuming.

Mr. Saxby : I think it is only fitting that we should pass a vote of thanks to the Local Committee for their untiring efforts to make the Thirteenth Annual Convention of the Canadian Electrical Association the success it has been.

Mr. Gossler seconded the motion.

The President put the motion, which was carried.

The President conveyed the vote of thanks to the Chairman and Local Committee.

Mr Smith : I was the Chairman of that committee, but they say the most successful business man is the man that gets the other man to do the work. I have succeeded beautifully and we will hear from Mr. Campbell.

Mr. Campbell : I was simply going to make the remark that I wasn't chairman of that committee when you addressed your attentions to me. I certainly, on behalf of the Local Committee, accept very kindly your expressions of pleasure and appreciation of the entertainment provided. I felt myself somewhat at a loss so far as any energies I have exerted in the matter are concerned, to know what was best to do ; at the same time the committee and myself are pleased to learn you have enjoyed yourselves and that what we have done for you has been appreciated. I thank you very much. (Applause.)

The President : I think that finishes the business so far as I am concerned, and I would ask Messrs Smith and Hunt to be present you with new President, Mr. J. J. Wright, by proxy. I will ask them to conduct Mr. Higman to the chair and Mr. Higman will preside over the meeting to its conclusion. (Applause).

Messrs. Smith and Hunt conducted Mr. Higman to the chair amid applause.

Mr. Higman : Gentlemen, this is a somewhat extraordinary proceeding, but it would be discourteous on my part to refuse ; and on behalf of my very dear friend, Mr. Wright, whose illness I deeply regret, and whose election I am just as well pleased as any one in this room, I accept the position. I have been on the Executive ten years and have endeavored when opportunity offered to do what I could for the Association. I found, however, during the past year that it was not possible, in attending to my other duties, to be present at any of the Executive meetings and because of this I had determined to retire. It does not mean, of course, that any little effort I have been able to make on behalf of this Association in the past will not be made in the future. I shall be very pleased indeed to do all I can to help the Association along. I think a desire has been expressed that something further should be said in regard to the two papers that were read yesterday on which the discussion was not concluded. Would Mr. Russell, who read one of the papers kindly open the discussion.

Mr. Russell : I hardly know on just what points you desire further information. You heard the paper yesterday, you have it in printed form, and I would like very much before saying anything further to hear from some of the members just what they desire to know in reference to any particular point and I will try to answer their questions to the best of my ability.

Mr. Dion : In connection with this very able paper by Mr. Russell, I would like if possible to emphasize the fact that there is a large field, it seems to me, in lighting companies for the single phase motor. We are operating alternating current and direct current motors. Until last summer we had supplied power by direct current only, and when our plant was rebuilt and we made provision for supplying alternating power we found it necessary to continue the supply of direct current to customers who were provided with direct current motors. For that purpose we have provided a rotary converter which is sufficient to carry the load of the direct current motors. We determined from that on to encourage the use of alternating current motors, our supply is two-phase, 60 cycles. Owing to the fact that the field for power in our city is not a very large one—we are not a manufacturing city in any large sense—and that the number of motors would not be very large, and because we had application for some comparatively large-sized motors and for other reasons we decided to run our power circuits entirely independent of our lighting circuits. We established a two-phase four-wire power circuit and up to this time we have operated that on a separate generator from the lighting. We have been able to do hat. But we were confronted with the problem from time to time of supplying alternating power to sections of the city remote from sections where one would expect to get motors, and we either had to, at considerable expense, extend our power distributing system to these places or use single phase motors. We had not done much of that yet, but I can see this problem will be before us again and I feel that for such places we could use single phase motors to advantage. Of course, I would limit the size of the motor to be so used ; I would not care to use a very large single phase motor on a lighting circuit ; but as was said here yesterday I think it is a question as between the capacity of your circuit and the size of your motor. If the motor is run steadily all day no trouble will result. If the motor is to be started and stopped often then you have to be careful that the capacity of your circuits is such that frequent starting and stopping will not interfere with your lighting system. But I think many occasions arise where the single phase motor can be used with considerable advantage. You may have noticed from the diagrams which were exhibited yesterday that the starting torque of these motors is very large and the period of acceleration is very short, and I think it is possible to operate motors of small size on our lighting circuits without any disturbance to our lighting service. There is one point in connection with the single phase motor upon which I would like to get some more information, speaking now of the Wagner motors ; it is the short circuiting device. This device is composed of a great many parts which are attached to a centrifugal arrangement which, when the motor has obtained its normal speed, throws these parts against the inside of the commutator, short-circuiting it, and after that the motor runs as an induction motor with short-circuited rotor. It occurred to me that mechanically this might be a weak device and a source of trouble. We have not had experience enough to allow me to express an opinion one way or the other, but from those who have had experience I would like to hear whether that device is going to be a source of trouble or whether it is a reliable device. Otherwise with my limited experience I have found the single phase motor to operate very satisfactorily.

Mr. Hunt : I would like to ask what is the exact size of the single phase motors you have on now ?

Mr. Dion : The largest size is 7½ h.p.

Mr. Hunt : These you put on your extreme limits ?

Mr. Dion : Yes, the 7½ h.p. motor is at the extreme end of our distribution ; it is about three miles from the central station.

Mr. Hunt : What voltage do you deliver ?

Mr. Dion : 2200 volts ; this motor is I believe about 500 volts ; it is a reduction of 4 to 1.

Mr. Hunt : You have to put on a separate transformer ; you don't take it off your lighting transformer ?

Mr. Dion : No.

Mr. Hunt : Have you had occasion to take it off your lighting plant transformer ?

Mr. Dion : No, we have not done that.

Mr. Russell : It is perfectly feasible to use a standard lighting transformer to operate these motors. The standard voltage for which we wind those is 104 or 208 ; you usually use either a ten or twenty to one ratio transformer for your lighting circuits and as the motor is wound for either 104 or 208 volts you can of course use that transformer. The motors are wound with that object in view.

Mr. Hunt : What range of voltage have you on it ?

Mr. Russell : A 104 volt motor will operate perfectly satisfactorily on a voltage from 100 to 120 or 208 to 240 volts. Where you run a greater voltage, if the customer will only inform us, we will be glad to wind the motor accordingly.

Mr. Hunt : That will cover the case I have in mind.

Mr. Russell : Mr. Dion spoke with reference to the short circuiting device of the motor. By reference to figure 4 in the paper you will gather a good idea of the internal construction of that motor. The ones we used to make were of iron with a rubber bumper so that when they fly off and took the brushes off and short circuted the blow was not very severe. The short circuiting clips which are used to short circuit each commutator bar to one common ring are of very substantial construction. We have experienced no difficulty whatever with this device. As these clips make contact with the commutator bar before the brush leaves the commutator there is never any burning or arcing there. It was only a few days ago I had occassion to see a motor that was taken apart, 30 h. p., operating a large printing press. Those short circuiting clips had been in operation continuously for a little over five years and they were I may say in more perfect condition than when put in, for they had had a certain amount of wear which enabled them to make a better contact than they made when they left the factory. That short circuiting device is simple in its construction. To have the governing device operate according to the frequency of the circuit it is only necessary to have the spring of the proper tension. For instance, if you wish a 60 cycle motor and you have a 66 cycle circuit, if you will so inform us before that motor leaves the factory, we will put in a governing spring of the proper tension. If you should have a 60 cycle motor and wish to run it on a 66 cycle circuit it is only necessary for you to tighten that spring up to the proper tension. You may need to practice with it two or three times to get it to release at the proper speed. You do not want it to release at too low a speed or you will not be able to bring up your full load, or you do not want it to release at too great a speed or your governor might drop back when you put on a full load ; but that should not happen until the speed has come down to about 1600 revolutions on a motor operating on 60 cycles. The same principles apply to a 133 cycle motor. The winding on the fields is all hand work. Great care is taken in winding so that the percentage of troubles from any cause has been less than one-tenth of one per cent. in the last four years. In Chicago they have between fifty-five hundred and six thousand horse power Wagner motors ; in the city of St. Louis about 4,000 ; in Boston there is about 600 h.p. It is only since the first of the year they have had current that they cared to put the motors on, for they had been changing their system. They have a single phase system there now. We have about 3,000 h. p. in Philadelphia. There is hardly a station that is operating a day circuit that has not one or more of our motors on it. Frequently the small central station man thinks he is not able to get customers enough to warrant him starting a day circuit. I have given considerable time to that one feature of the business in the last seven or eight months and I have found that if a man would just get after the motor business that he was enabled to get a sufficient number of motors to give him a day load from which he derived a revenue sufficient to pay for operating the day load, probably not to make money on it at the start, but sufficient to pay his expenses, and they were in nearly every case surprised to see the amount of current they sold for other purposes ; and then gradually more motors were added as people saw the advantages to be gained from using motors for operating different pieces of machinery. A great many central station managers have the impression also that they must have large generators to successfully operate single phase motors or any other alternating current motors. I have a list of a few small stations that have been quite successful in getting a good day load. At Henderson, Kentucky, they have two generators, 1-75 k.w., 1-150 k.w., and 10 motors aggregating 36½h.p.; they operate the larger machines most of the time during the day and then at night they throw on the smaller machines to help carry the increased night load. At one place in Illinois, they have one generator of 75 kilowatts and they operate a number of motors of small sizes for various purposes, totalling about 100 h. p. It would possibly be of interest to you to know something of the installation of a 25 h.p. motor there operating the pumping plant. It is 1½ miles from the central station located out in the country. They start their pumping along about 12 o'clock at night after their principle load has come down. They start the motor by simply closing the primary switch of the distributing circuit at the power station and the motor comes up to the speed, throws off its brushes, and the water starts ; when the tank is about full it rings a bell in the power station and the attendant pulls the primary switch. A man goes down there once a week to see that there is plenty of oil in the oil reservoirs in the pumping apparatus and to see that there is oil in the bearings of the motor. They have never had but one break down or one shut down of that pumping plant in a little over three years during which time it has been installed, and it is operating every day, and that break-down was due to a ground on the transformers. I might mention another instance where the installation of one 10 h. p. motor is rather unique. It is located out on a farm two miles from the city. That motor is operated on a stone boat; they haul that motor out in a field adjacent to the barn and carry current to it with a cable ; they operate a cross-cut saw for sawing cordwood, also corn shedders; they haul it into the barn and belt it to a small jack shaft and from that drive their corn grinder, oat clippers, deep well pump and cream separator. I went out there last winter and I found the motor up on a pile of snow ten feet high operating a corn shredder ; it had a box over it to keep the snow off. I am sure if you will ever try one of the motors in your city, if you have proper materials upon which to work, you will not have any trouble in working up considerable new business. Sixty cycle motors up to and including ten h. p. operate at 1750 at full load. The synchronous speed would be 1800. Although we can give you a slow speed 60 cycle motor in all sizes operating at 1165 and 870, yet those motors are not used very extensively except where it is necessary to operate at slow speed, for direct connection or some special installation. One hundred and thirty-three cycle motors operated at 1940 r. p. m. at full load up to and including ten h. p., and 1550 r. p. m. for the larger sizes.

Mr. Read : In our plant we are using 104 to 208 and we find the 208 volt motors on the three wire system seem to work satisfactorily. The largest capacity of single phase motor we have is three h. p. ; we are using it on our lighting circuit with the short circuiting device and we had a little trouble; the short circuiting arrangement in one place ground at the core of the rotor and we had to take it apart and in that way we found its defect, but that is the only trouble we have ever had. We are using three h.p. motors in our sub-stations and on our air blast transformers. All the motors we got at first were 208, but the last motor we got from the other side was 104 and it was very satisfactory under the conditions we had, but I would advise that you should use 208. I notice with single phase motors especially, connected with the three wire system, each time you start the motor you will get a kick in the light, but it comes back alright. When the lighting load is on you will not notice it so much. As far as our experience with single phase motors goes, I think the 208 volts is the most satisfactory for our system.

Mr. Russell : We probably ship out nine out of ten of our motors wound for 208 volts. The reason is that it enables the balancing of the transformer and the lighting circuit ; and where you run off the outside of the circuit it enables you to do so with about half the copper.

Mr. Read : In the railway end of our sub-station we have a Wagner 3 h. p. single-phase induction motor, 300 volts, on the same shaft with a small rotary converter. The motor is used for starting the rotary, also to keep it from hunting and flashing, or dropping out of step with excessive overloads which the rotary is subject to in starting a 250 k. w. motor generator set. This motor can be cut out when rotary is in step with system, but we have never put a load on with motor cut out, as the rotary would hunt and eventually drop out of step. This motor has proved very satisfactory, and has operated under some very trying conditions and severe overloads. The brush releasing device gave us a little trouble at first, not being adjusted properly to suit our system, as it was a 60-cycle motor operating on a 66 cycle system, and consequently the brushes would leave the commutator too soon before the motor had reached a high enough speed to drop into step and take its load, but after tightening springs on brush releasing device, we found it worked very satisfactorily, and has given no more trouble since.

Mr. Holman : Speak of the induction motor that you have at St. Romuald, comparing it with the one and one-half single phase motor that you have somewhere else and speak of the relative troubles you had with othere.

Mr. Read : As far as our trouble is concerned, in the two-phase system we are using two-phase three-wire and we have in that section of our system about five motors altogether, two 15, a 10, a 3 and a 2 I think, and they are all two-phase. We have had trouble occasionally not only from the motors but from our transformers, and it being some distance from our station it is rather awkward for us. Our sub-station is situated at Levis and we transmit back part of the way, and we also have a sub-station at St. Romuald which does not require an attendant. We have two Westinghouse transformers there and we have no trouble with them. We have them connected up to three-phase transmission and two-phase three wire secondary. Our two-phase motors there have been satisfactory, except as I mentioned before, we have had a slight trouble with the transformers, but with the single-phase motors we have had no trouble except that which I mentioned first, in the short circuiting device. It was one of the first motors we got ; it is the open type, I believe one of the first type the Wagner Company got out, and it came to us with the air blast transformers and has operated them about a year. We have two motors and we exchange them ; we run one motor for a few days and the other for perhaps the same length of time. We found that after a while one of the motors began to act up a little ; it began to blow fuses and the brushes would not come off, apparently some inherent defect. By examining it we found that the short circuiting ring inside the armature was grounded to the core. The other motor has been running continually since and we have had no trouble at all with it. The only trouble with our other motors, being 60 cycle motors, single-phase operating on 66 2-3 cycles, is the trouble with the brushes leaving the commutators too soon before they are really up to speed, and taking the load and dropping back and coming up again, but by tightening the springs and getting the right adjustment we have had no further trouble in that respect.

Mr. Russell : It is only a question of adjusting your governors for that purpose.

Mr. Dion : Apart from the question of frequency, assume that your short circuiting device is properly adjusted and that you overload your motor so that you get a drop of speed from the normal, how much of a percentage of reduction would be necessary to allow this device to go back and throw the brushes on again, and what will happen then, what will be the result to the motor ?

Mr. Read : We have a single phase motor on a 104 volt circuit ; it has just been put in recently ; it is operating a pump organ and there was a new governor which the organ man was trying, and he figured out it would take about one h. p. to run this organ, but this governor was not adjusted at the time satisfactorily, so we put the motor on with this governor which took almost one h.p. to bring up to speed and the motor slowed down to about twenty-five per cent. below the rated speed, but still the brushes held on and the motor was carrying almost two h. p. while it was a one h. p. motor. We did not run it any length of time when we found out what the trouble was. Since the governor has been adjusted we find that the motor is rather small and we are installing in its place a three h. p. motor, under 208 volts.

Mr. Dion : That seems extraordinary.

Mr. Read : There are very funny conditions under which this organ is pumped. They had a ninety-foot belt drive and the motor was placed in the basement ; they had three different sections of the belt and there were a number of idler pulleys, as they could not get a direct drive. This gentleman had said they had no trouble with the direct current motors because they could put them right in the organ. Under the conditions they had in there they had to place this motor down stairs and that was the reason it took so much power.

Mr. Wyley : What is the rule where a transformer is required for the motor? Does the company or the customer supply it ? The company in our case.

Mr. Dion : In reply to that I would say that we have not been very long in the alternating power business. The number of motors installed is not large as yet and I don't know that our policy is clearly defined. Up to this time we have in some cases supplied the transformers on a three year contract and for less than three years we asked the customer to provide the transformers.

Mr. Higman : A dispute between a supply company and a customer in regard to the load that is being supplied has been referred to our officers. The supply company undertakes to sell 75 h.p. through an induction motor, and the consumer complains that he only gets 60 h. p. at the pulley. It is simply a question, as I understand it, as between true energy and the apparent energy. I would like to know what the custom is with central station managers as to who stands up for the wattless current ? Perhaps some one will answer that question.

Mr. Dion : I would like some one to answer that for me, too. I would be glad if Mr. Russell would answer my question, which was partly answered by Mr. Read, as to the over-loading of a single phase motor, the dropping on of the brushes, and what will happen.

Mr. Russell: If you should over-load one of our motors sufficient to bring the speed down to about 1700—with some of them the speed might drop down as low as 1400 before the brushes would go back on the commutator—if they did go back the motor would only repeat its starting again; it would try to pick up the load and carry it.

Mr. Dion: But the brushes would drop on the commutator before the short circuiting device was taken up?

Mr. Russell: Yes, sir. Suppose a customer were continually over-loading his motor—in fact you have a number of customers doing that—he would have to over-load his motor twenty-five per cent. before the speed would drop down sufficient for the brushes to bear on the commutator.

Mr. Parke: That is quite a common occurrence. Supposing it was a central station plant and you had say twenty per cent. of the customers over-loading your motors, and on account of the over-loading the speed were dropping down and the short circuiting device being thrown out and thrown in again, requiring in order to start it under that over-load a very considerable starting current, wouldn't you be likely to have a section of your system interfered with and almost impossible to control?

Mr. Russell: I would say yes, but wouldn't that be the same with any other motor, were there a tendency to continually overload the motor. Such a condition is an exceedingly good indication that something should be done to relieve the motor of its overload. The conditions you mention are of rare occurrence.

Mr. Parke: It probably would be the same with other motors, and in a case of motors without the short circuiting device I do not think you would have that cutting effect.

Mr. Russell; They would drop out of step.

Mr. Parke: In that case they would stop.

Mr. Russell: Yes.

Mr. Parke: The point I want to get at is this, there would be no device in it to cause it to cut itself out of service.

Mr. Russell: No sir.

Mr. Holman: I would suggest that this might be a good feature. When the over-load comes on you not only hear the click of that "thing," but you see the other effect of slower speed in the machine that you may be driving. You get both the ear and eye effect in having your attention drawn to the fact that something is wrong with your speed. In other words, a passing attendant belonging to the power company, if he was in the shop, would hear the click and then his attention would be called to the fact of what otherwise he would not see.

In reply to the question as to whether he had had any experience in operating passenger elevators with single phase motors, Mr. Russell said: Yes. I don't know that I can advocate the single phase motor for operating a passenger elevator, for it must be constant, and it is necessary for you to drive your passenger or freight elevator by a belt from the motor to a countershaft and use a device to stop and start and lower your elevator and you all know what kind of an arrangement that means.

Mr. Scott: I have been very much interested in this discussion. It is of great interest for those who are connected with the manufacture of motors to hear a discussion of the motors by those who are using them. There are two questions which are involved in the paper before us, one, the characteristics of the single-phase motor itself, and the other is a point which has been taken up somewhat in the discussion, the comparison of this motor with other motors from their operating standpoint. It seems to me that the parallel may not be unlike that which we had a day or so ago when we were discussing the direct current motor and comparing it with the alternating current motor and motors of different types; and as in all else, each probably has its own field which it can fill in particular cases better than the other. So here we have the single phase motor and the polyphase motor and there are certain conditions, respecting supply circuits usually, where it may be preferable to use one in one case and the other in another. Comparison was made the other day between the induction motor and the direct current motor; it was found that in general it was the consensus of opinion that it was the desirable thing to use the induction motor if possible. Now, on general principles, which of the two types of motor the alternating polyphase motor or the single phase motor is preferable? There was one statement I noticed in the papers read yesterday, namely, that the single phase motor is very simple in its operation and requires no more attention or care, if I remember the expression, than the polyphase motor. Take the polyphase motor in its simplest form and it is hard to see how anything could be simpler or if different from it could be as simple as that. Anything that has small auxiliary contacts or brushes or moving parts, although they may be made well and seldom get out of order, constitute a possibility of trouble which does not exist when these are not present. As to the point which has just been brought up, of the overloading of the motor. It is one which has its different aspects. The induction motor is a motor which stands abuse. I once, not long ago, heard this comparison made between the horse and mule: The mule is an animal that would work hard but he knew when to stop, he wouldn't overwork; you could kill him but he wouldn't kill himself. Take a horse and the horse goes into things with all his energy and don't know when to stop and with a little encouragement he would over-work himself and drop dead with his own exertions. It seems to me that the induction motor is a motor which will work right along, it is a good deal of a mule, it is not very apt to get into trouble by over-load, as it has no brushes and commutator to spark as has the direct current motor, and it has no centrifugal device to work back and forth as may occur in a critical condition with the single phase motor. But the alternating current motor is well-known to be a motor which does stand over-loading, intermittent over-loads and continuous overloads. But like the mule it will lie down when the limit is reached without making a fuss at the commutator. Motors carrying twenty-five and fifty per cent. overload for long periods are not rare by any means, and it seems to me from the station standpoint there is a common sense consideration of simplicity both in construction and operation and also in the desirable operating element that the motor when over-loaded has nothing to get out of order and is capable of carrying a very considerable overload to a very high limit. Of course, a very long continued heavy overload would burn out the motor, which would be the case with any other motor. These things give to the polyphase induction motor a claim to recognition which is not possessed by any other kind of motor—a claim upon the central station manager and upon the customer—one of simplicity and durability. I do not put that forward as an argument to prove that you should never have the direct current motor or the single phase motor, but it is one of the points which to my mind is well worthy of consideration.

Mr. Reesor read an invitation from the Hamilton Steamboat Company inviting those of the members, who desired to do so to take a trip on their boats.

Mr. Mortimer moved, seconded by Mr. Fisk, that the thanks of this Association be tendered to the Toronto newspapers for the very accurate and fair reports they have given of the proceedings of this convention. Carried.

Mr. Dion moved, duly seconded, that the thanks of this Association be tendered to the DeForest Wireless Telegraph Company, The Toronto Railway Company the Metropolitan Electric Railway Company and the Hamilton Steamboat Company for their courtesy in extending invitations to the members of the C. E. A. Carried.

At 1 o'clock p.m. the convention adjourned sine die, to meet in Hamilton in 1904.

SOCIAL FEATURES.

The Niagara Navigation Company offered members of the Association a special rate to visit Niagara Falls.

The trolley trip to Aurora and Newmarket on Friday afternoon over the Metropolitan Electric Railway, was participated in by a number of the members who greatly enjoyed President J. W. Moyes' hospitality.

The Hamilton Steamboat Company offered free transportation to members wishing to visit Hamilton, by the steamer "Macassa," and witness the receiving and sending of wireless telegrams by the De Forest Wireless Telegraph Company whilst the boat was crossing the lake. A number of the delegates took in these trips.

The excursion over the bay to the Island on Wednesday evening revealed a boat load of jolly electricians with their wives and lady friends. A special boat had been chartered—the "Chippewa"—and the famous band of the Queen's Own Rifles discoursed sweet music. At the Island a vaudeville performance was given in the open air theatre. The party returned at 11 p.m., well pleased with the Toronto local committee's generous hospitality.

The feature of the first day was the tally-ho drive to all the principal points of interest in the city. This was given by courtesy of the Canadian General Electric Company. Nine large tally-ho's with the largest electric automobile on the continent and a number of private "autos" made up a procession which attracted considerable attention. In each tally-ho was a guide who blew a long brass horn as they approached the crossings, and who also pointed out the points of interest.

By courtesy of the Canada Foundry Company, several special cars took the members and their friends out to the company's works at Toronto Junction. The trolley cars were all lavishly decorated with flags of all kinds. They were met at the works by Messrs. A. Oakley, S. M. Gray, H. G. Nicholls, J. J. Ashworth, A. C. McCallum, J. Leicester, and O. Rouleaux, officials of the company, and escorted through the vast plant. Keen interest was manifested in the making of rivets, bolts, punching of heavy plate, the working of the massive cranes, etc.

At the conclusion of the tour of the various buildings the whole party were escorted to the new store buildings, where an elaborate luncheon was served. The whole room was tastefully draped and beautifully decorated with palms and bunting. The delighted party were afterward taken back to the King Edward Hotel in the special cars.

THE BANQUET.

The annual Association Dinner at the King Edward was a magnificent affair. The beautiful palms and ferns, the exotic flowers and miniature trees, the gaily decorated tables, etc., all combined to make a "tout ensemble" worthy of the King's Palace.

The dinner was held in the beautiful American dining-room. The menu card was a clever conception. The following are samples of the articles discussed at the festive board and their electrical synonyms :—"Electric juice," cocktail, 100,000 volts; "submarine insulation," little neck clams ; "direct current," chicken a la reine; "deep sea cable," fillet of black bass ; "high resistance," cucumbers; "sliding base," punch—belt driven ; "electrocuted," broiled spring chicken ; "carbon points," asparagus vinaigrette ; "tie wires," cheese, crackers; "grounds," coffee; "incandescence," cigars. Mr. B. F. Reesor, Lindsay, President of the Canadian Electrical Association presided. The toast of "The King," was loyally received, and followed by that of "Our Empire."

A splendid international feeling prevailed, and the various speakers dwelt upon the unity of the English speaking races. Col. Denison was the principal speaker of the evening. His theme was our Imperial relations.

"The Electrical Interests" brought a happy reply from Mr. A. A. Wright, M. P., Renfrew, in which he referred to the power possibilities lying loose all over our country. Mr. C. F. Scott also spoke, giving an interesting review of some phases of recent electrical progress, Mr. G. U. G. Holman, of Quebec, also spoke. The toast of "Our Guests" was responded to by Ald. Ward and Dr. J. O. Orr.

Letters of regret were read from Hon. Geo.W.Ross, Hon. J.M.Gibson, Mr. J.P.Whitney, Mayor Urquhart, Mr. Frederic Nicholls, Mr. H. P. Dwight, Hon. Rich'd Harcourt, Col. Pellatt, Mr.W.H. Browne, Mr.Stephen Noxon (Ingersoll), Mr. E. H. Keating, Mr.K.B.Thornton, Montreal, and Prof. Galbraith, Toronto.

Speech-making was only a part of the programme. The musical entertainment included excellent orchestral numbers, solos and recitations by Mr. Arthur Blight, Mr. J. B. Coulthard and Mr. W. A. Martin, and witty speeches by many present.

A very thoughtful act on the part of Mr. A. B. Smith, of the G. N. W. Telegraph Company was in having the room where Mr. J. J. Wright was lying ill, connected by telephone so that the latter heard all tha passed in the banquet hall.

THE TRAINING OF THE HIGH TENSION ENGINEER.

By P. M. Lincoln.

Why, you ask, have I chosen to discuss this matter of the training of the engineer instead of some phase of practice or theory of high tension. Why talk about education instead of the maximum voltage that can be used in an electrical transmission or the proper spacing of high tension conductors, or the maximum distance to which power can be profitably transmitted? My answer is, because I consider the human element of this transmission problem of more importance than the material element. An electric transmission is a creation of ideas, of engineering ability and skill rather than one of mere poles and cross arms and copper. The indispensable part of the transmission is the man of ingenuity and enterprise and energy. Get the right kind of a man and long distance transmission is practicable ; without him, all kinds of trouble are likely to develop.

There are two schools in which the electrical engineer may receive his training, but only one in which he must receive a course before he can be called a high tension engineer. Those things which are learned in the schools equipped with professors and laboratories and mathematical text books must be supplemented by the things which can be learned only in the school of experience. These two schools are quite different in method. The college instructs in theory and in those methods of doing things which have become standard by universal adoption. The college teaches positive knowledge. In the school of experience, on the other hand, one is more apt to learn how not to do it, and by the elimination of the unsuccessful, arrive at the goal of success. The knowledge gained by experience is more often negative.

Who is it that answers the innumerable queries that arise when a transmission scheme is in question? It is the engineer. The engineer decides what voltage shall be used, what frequency shall be adopted, what loss is the most economical, the proper cross section of copper to be used, the distance apart of the conductors, the kind of insulators, the spacing of poles, the height of conductors above ground, and the thousand and one other questions that arise. It is on the engineer's knowledge and skill that the success of the transmission depends.

It is to the man—the engineer—then that we look for advice on matters pertaining to high tension transmission. How is the engineer to gain the necessary wisdom to give such advice? In two ways :

First—By mastering the laws which underlie the science of electricity—the training as given by the college education.

Second—By coming into contact with the problem personally—the training as given by experience.

Both theory and practice are needed to make the complete engineer. He may pick up theory while engaged in practical work, but he can never pick up practice while engaged in theoretical work.

Put to the fresh college graduate the problem of the amount of distance to be left between the conductors of a high tension transmission line. His answer will involve most likely the jumping distance of the voltage to be used, the length of span, the sag, and perhaps a liberal factor of safety. It is experience only that will show that his premises are wrong and that the equation to determine spacing of high tension wires depends very little on the voltage to be carried and almost entirely on such things as the average length and ohmic resistance of cats, the spread of wing of owls and cranes and eagles, and the average length of scrap baling wire, together with the strength of the average small boy's throwing arm.

The college graduate enters practical work invariably feeling that the greatest danger of his work lies in his liability of receiving a shock from the high tension conductors. Not until he has had experience with accidents of an electrical nature does he learn that it is the danger of being burned that he has to fear more than the danger of shock. My own experience, and I think it will be checked by the large majority of those in a position to know, has been that the number of electrical accidents in which the victim has been injured by burning is incomparably greater than the number from shock.

The graduate has learned how to make accurate measurements of power. He finds after he has been "up against it" that it is easier to measure power accurately than it is to persuade the customer that his power is being accurately measured.

The man fresh from the college laboratory enters his practical duties with the idea that rubber is one of the best insulators that exists. It is not until he has seen rubber insulation break down in the most unaccountable manner that he finds that rubber as a high tension insulator is extremely treacherous. The deterioration of rubber insulation is probably due to chemical reactions on the rubber induced by the brush discharges, which are in turn caused by the high voltage of the conductor.

The newly made graduate usually has a high opinion of efficiency and can calculate the economy of a transmission to an excessively small fraction. When he becomes responsible for the operation of a transmission line, however, it does not take him long to find out that efficiency is a vanishing quantity when compared to continuity of operation, and that economy is not to be considered as being in the same class as good service.

The technical graduate, in short, may have knowledge a-plenty, but his wisdom is to come.

It is furthest from my thoughts to cast any slur upon the technical graduate. I look back upon my own course in electrical engineering and feel that it is the most valuable asset I ever possessed. The technical course is the best of foundations, but it is only a foundation. The end of the college course is rightly called "Commencement." The great advantage of the technical education is that it gives the man proper equipment for overcoming the difficulties with which his experience is bound to bring him into contact. It gives him, as nothing else will, the power of initiative—that most valuable quality that a high tension engineer can possess. There is nothing like the college education to equip a man for making every accident a lesson in "how not to do it," and every failure a stepping stone to success.

Take, for instance, the recent accident to the Niagara plant, in which a fire destroyed the cables on the bridge connecting the power house with the transformer house. The lesson to be drawn from this accident—so plain that he who runs may read—is that where many cables are run together extreme precaution should be taken to protect against danger of fire. Before the occurrence of this fire there was little suspicion that the insulation of cables when lead covered or protected by fire proof braid — as was the case at Niagara—is sufficient to maintain so fierce a blaze without the aid of some other combustible beside the insulation. One accident of this kind should suffice, not only for the Niagara Falls people, but also for any others who have occasion to run many cables together.

The need of high tension engineering is for men; men with education; men with brains; men with experience. Where shall we get these men? How shall the supply keep pace with the demand? The members of the Canadian Electrical Association and of kindred societies are best qualified to answer this. You are the men who are now operating and designing transmissions. If you treat your knowledge of these things as if it were a plague, cork it into a bottle and label it "poison," the art of long distance electric transmission must surely suffer therefrom. You are the teachers, the professors in the school of experience. It is to your pupils that the next generation must look for its engineers.

You will pardon me for referring here to the work that the American Institute of Electrical Engineers is carrying on through their Transmission Committee. They were appointed for the purpose of "collecting data respecting present practice in electric transmission at high voltage." They are now engaged in that work. Whether their labors are successful or not depends not so much on them as on you. Without the co-operation of engineers in general their work of collecting data and of presenting a report thereon cannot succeed.

One of the methods which this Committee has been using to obtain data and get it for the Institute is to prepare and present to the Institute a series of brief Introductions to Discussion. The object of these Introductions is not to treat the subject on which they are written completely, but rather to simply put the matter before the Institute in such shape that the points raised can be discussed by those who are in position to give opinions of value. A mere statement of the subjects which have been written about, and a brief resumé of the matter in which the subject was treated, may be of interest in this connection.

On March 27th there were presented to the Institute the following four Introductions to Discussions:

"Mechanical Specifications for a Proposed Standard Insulator Pin," by R. D. Mershon. This, as the title will indicate, was a discussion which proposed standard dimensions for all future insulator pins for high tension lines. The reasons for wishing to adopt a standard insulator pin are apparent.

"The Testing of Insulators," by F. O. Blackwell. This is a paper which describes the methods which experience has shown to be the best in testing high tension insulators.

"Transposition and Relative Location of Power and Telephone Wires," by P. M. Lincoln. This paper gives a discussion of the influence on telephone wires by the action of high tension wires on the same poles, as well as proposing some methods for overcoming the difficulties thus caused.

"Burning of Wooden Pins on High Tension Transmission Lines," by C. C. Chesney. This is a discussion which treats of the disintegration of pins on high tension lines. This disintegration does not always occur, but it has been frequent enough to raise a considerable question. This paper shows a number of photographs of pins so burned, and briefly discusses a remedy.

At the Annual Convention an entire day is to be devoted to the discussion of high tension subjects. A number of Introductions to Discussion have been written for presentation on that day; they are as follows:

"On the Testing of Electrical Apparatus for Dielectric Strength," by P. H. Thomas. This is a paper which briefly discusses the testing of electrical apparatus, both before installation and after installation. It points out the risk which is apt to be taken in giving apparatus high potential tests after its installation.

"Methods of Bringing High Tension Conductors into Buildings," by C. E. Skinner. This is a discussion of the various methods which have been used in the past for bringing high tension wires into sub-stations and main stations; it also gives sketches showing a proposed way of accomplishing this object.

"Y or delta Connection of Transformers," by F. O. Blackwell. This discussion treats of the relative methods of Y and delta systems of connecting transformers for high tension transmission. The subject is one of considerable importance and deserves careful study.

"Choice of Frequency for Very Long Lines," by P. M. Lincoln. This is an analysis of the various items which enter into the choice of frequency for long transmission lines. The drift of this discussion is that as the distance of transmission increases it becomes advisable to decrease the frequency.

"The Grounded Wire as a Protection Against Lightning," by R. D. Mershon. This is a discussion of the theory of lightning protection by a parallel grounded circuit. A number of new points are brought out and the value of such protection from a theoretical standpoint as well as some practical experience along the same lines are pointed out.

"The Operation and Maintenance of High Tension Underground Systems," by Philip Torchio. This discusses the various points that enter into the operation and maintenance of a large underground system of high tension conductors, giving methods of testing and a considerable amount of valuable data in connection with cables.

"Electric Cables for High Voltage Service," by H. W. Fisher. This paper gives a number of valuable points in connection with the manufacture, installation and operation of high tension cables.

"The Use of Automatic Means for Disconnecting Disabled Apparatus," by H. G. Stott. This is a discussion on the value of automatic apparatus for disconnecting any part of the system, including generating apparatus, transmission apparatus, and receiving apparatus.

The value of reversed current breakers is taken up and discussed, as well as the application of simple overload devices.

You will note that all of the subjects above mentioned are of vital interest, and information concerning them will be eagerly sought by all persons interested in the transmission of electrical energy. It is the intention and mission of this High Tension Transmission Committee to bring before the American Institute of Electrical Engineers as much data on these subjects, and kindred subjects, as possible.

The art of long distance electric transmission as it exists to-day is the result of the accumulated experience of all those who have had to do with transmission work. And the process of accumulation is still going on. Those men who are to-day designing and operating transmission plants are the moulders of the art. Their expedients for improving service or reliability or for cheapening cost are noted, and when successful have their influence on future installations.

The experiences of to-day are incorporated into the text books of to-morrow. But, although the result of experience may be taught to the college student—allowing always for a considerable angle of lay—the college curriculum can never become the substitute for the school of experience.

VARIABLE SPEED MOTORS AND THEIR RELATION TO NEW SHOP METHODS.

By R. T. Lozier.

Progress does not always follow a single road; many times we find it advancing along converging byways which come together in the main highway along which it then rapidly goes towards its destination, which is the ultimate ideal.

Many times those travelling the byway know little of the companions which they are to join at the cross roads, and so it was that where George Bullock ten years ago in his first shop decided to put individual motors on his tools because it appealed to him as being good engineering, he little knew that on a parallel road Ward Leonard was progressing with his Multi-Voltage System for controlling such motors, while on still another road the engineers at Bethelem, Pa., and elsewhere were determining how to run a shop from the standpoint of true engineering rather than by the rule of thumb.

The speed of the individual motor could not have been fully controlled successfully if it were not for the Multi-Voltage System which would never have had its application if it were not for the development of the individual motor, and the new shop methods could never have reached their present development if it were not for the individual motor properly controlled. In fact, the shop methods would never have gone beyond the highly developed theory of the academician. I am not losing sight of the possibility of using a mechanical means of varying the tool speed while it works, but these devices have not been developed as yet.

What these three factors now joined together are able to accomplish is this: Working every machine tool in a shop at its highest output, thereby making it possible to increase the output of the average shop operating under the old conditions by 300 to 400 per cent.

This is the one great feature which is the resultant of these combined improvements which subordinates all others although of the latter there are many.

Let us consider for a moment each of these methods from its own standpoint and in its natural order.

NEW SHOP METHODS.

In days gone by, if a certain piece of work was to be done, a drawing showing the essential dimensions accompanied the stock which went to the machinist, who followed his own way in

a—Setting the work.
b—Selecting the cutting tool and grinding it as he best knew.
c—Choosing the running speed.
d—Determining the cut.
e—And adjusting the feed.

The completion of the work was

1—Limited by his intelligence.
2—Restricted by his experience.
3—Governed by his inclination.
4—And was subject to the limiting conditions laid down by that despot, "the walking-delegate."

Result: Four hours taken to do what could be accomplished in less than one, and with a greater degree of accuracy in the latter case.

The first step towards improvement was to take the method of doing the work out of the hands of the operator and place it in the hands of an expert. This expert issued what has been termed a "method card," on which the machinist is told how to perform all the operations involved; setting the work, the kind of tool and its cutting edge, the cut and feed, and last, but not of least importance, the speed. It was at once found that the all prevailing method of driving from pulleys of fixed speed on to cones of limited range and few steps, was entirely too inflexible and greatly restricted the desired results; one step on the cones would be too slow and the next too fast. The exact speed could only be obtained by chance. Furthermore, it was found that the higher cutting speeds that were possible could not be obtained without changing the driving pulleys.

In the desire to work the cutting tool to its highest rate of displacing metal, exhaustive experiments were made in the quality and temper of the steel during which the so-called air-hardened steel was discovered. With this new steel it was found that a cutting speed of 100 feet a minute was ordinary, where 20 feet a minute with the old tool steel was the limit. Five times faster could the tools be run than formerly. But we find the highest speed obtained by the old arrangement of belts and cones five times below that required to work the new cutting tool up to its requirements. Change the pully ratios and speed up the cones and two conditions at once develop; first, the cones have not steps enough, before they were applied through a ratio of 7 to 1; now through a ratio of 35 to 1, and while the four changes were almost inadequate for the 7 to 1, now they are five times so. But that is not the only trouble; the belt will not pull the load, because the high rate of cutting the metal requires a proportionate increase in the power.

It is now readily seen that if we are to benefit by the new cutting steel and improved methods, we must have a means of driving the tool that will give it as much range of speed as is desired and as much power as the cutting tool demands to perform its work. We are all aware that subdivision of power by electric transmission is a good thing, but the element of broad speed variation brings it down to the individual application of the motor to the tool.

And now we are down to the meat of the nut we are cracking. What kind of a motor do we want and how much, and how are we going to vary its speed.

In most cases a standard shunt wound direct current motor of about 600 revolutions at 250 volts is the thing for all classes of work. Its principal features should be:

a—Its armature coils of a type designed to carry heavy overloads without deterioration of insulation.
b—Its design to provide for low armature reaction to permit of high speeds with weak fields without sparking.
c—Its structure to be of the protected type (but the enclosed motor is to be avoided except for special cases).
d—It should be on a condensed and handy form, so as to be conveniently applied to any class of tool.
e—It should be interchangeable so that it can be applied to any tool without being specially designed for that purpose.

In this manner a stock of motors can be drawn upon for such necessities as may arise and of such capacity as the particular tool in question may demand, one motor being readily exchanged for another should circumstances require.

It must be particularly borne in mind that this motor is no ordinary machine that drives a load, the maximum limitations of which are fixed by a belt that provides a means of slipping. The tool motor must be all "guts."

Now as to the range of speed that it must operate through This is really the backbone of the whole system and involves a careful consideration of every process of the work performed in the shop to be driven. It might be said, in determining the speed range for a shop, that the minimum speed of any one tool is determined by the hardest material it is to cut and having the largest surface to be machined, while the highest speed is determined by the softest or easiest material that is to be machined on the tool and having the smallest dimension to be machined. For example, if we have a lathe working high carbon steel, the surface to be machined having a diameter which is the limit of the tool's head stock, and we cut at a rate of 10 feet a minute, we may assume this to be the slowest speed that the tool's spindle will be called upon to run at. Now, if on the same lathe we expect to machine a piece of soft iron having a diameter to be machined 1-10 of the capacity of the lathe (that of the head stock diameter) we then have a circumference 1-10 of that in the first case, and the spindle must run ten times as fast to keep up the same cutting speed, but we can machine soft iron ten times faster than hard steel, i.e., 100 feet a minute, consequently our spindle speed must be 10 x 10 or 100 times faster than in the first case. This gives us a speed range of 100 to 1, which determines the limits of the speed for this particular tool if it is to be used for the purposes above described.

In determining the speed ratio to be used in a shop, it should be selected with a view to meeting the maximum requirements of any operation in this shop. Of course, there may be one or two special processes which may have a special speed arrangement for their particular cases, but it will be found that in the average shop the speed requirements vary within certain fixed limits that will apply to the majority of cases.

Having determined what our speed range is to be, the next step is to select the methods for obtaining same. Of these there are three, viz.:

1—Mechanical.
2—Electrical.
3—A combination of the Electrical and Mechanical.

Let us consider these in the order in which they come.

MECHANICAL.

Under this heading we have two sub-divisions—

a—Those devices that permit of a change in speed only when a tool is not doing work.
b—Those devices that permit of a change in speed when a tool is doing work.

Of the former there are the well-known and commonly used back gears, and I believe we can truly include the common cone pulleys, the belts of which are changed while the spindle of the tool is in motion, but hardly while the tool is doing work.

Of the latter, there is to be found a great variety such as the Evans' Friction Cone, Reeves' Pulley, Combination of gears and friction clutches which will release and clutch from one combination to another, sun and planet gears, etc., etc., but as yet no one of these methods has been able to fulfil all of the conditions of transmitting relatively large horse-powers at high speeds as demanded by the new shop methods. Each of these devices has perhaps its own application, but in a limited way only.

ELECTRICAL.

In the electrical system we vary the electrical conditions in the motor itself so that the speed may be changed within a given range with perfect ease, whether work is being done by the motor or not.

The relative advantages and disadvantages of these two systems may be stated as follows:

Any of the mechanical methods has the advantage that in reducing the speed of the tool, the size of the motor may remain the same if the same amount of work is to be done by the cutting tool. This does not hold true if the motor speed is varied within itself electrically.

The electrical method has the advantage that it can vary the speed of the motor as it runs, at will, and while the work is being done this has an advantage that the mechanical method does not as yet possess to anything like the same degree.

It therefore appears best to combine the advantages of the mechanical and electrical methods of control wherever the requirements of the case demand a large range of speed.

The practice now is to use a mechanical arrangement in connection with a variable speed motor, the former consisting of a single or double reduction back gear which enables the motor to reach the lower speeds of the range which are thrown out, and the motor run directly on the spindle in the higher speed range. It will be noticed, of course, that when driving through the gears the motor speed is varied in the same manner as when running direct.

Now, having determined the range of speed and the methods to be employed in covering same, the next thing is to determine exactly what part of the range the motor will cover by its own speed variation, and to what extent it must depend upon gears.

In my paper before the American Institute of Electrical Engineers of December, 1902, volume 19, No. 10, subject "The Operation of Machine Shops by Individual Electric Motors," I give graphic illustrations of the two methods of varying the speed of motors in such a way that the motor can operate constantly at any one speed of its range independent of whether the load varies or not while on that speed. Of these two methods one is the Multi-Voltage System, which reduces the speed of the motor, and the other is the field control, which increases the speed of the motor by weakening the field, and these two methods determine the range of speed that a motor can successfully cover. I might state that the Multi-Voltage System covers the amount of current that must be handled at the lowest voltage, while the field weakening determines the high limit when it reaches the sparking point of the motor, or perhaps the armatures peripheral speed. In common practice the speed ratio in the motor itself of 7 1-2 to 1 is found to fit the majority of cases. In this arrangement the lowest voltage is 90, and the highest 250, the field of the motor being weakened so as to increase its speed by 150 per cent. There are, however, several combinations to select from, and it is only necessary to determine just what rating a motor should have to get the desired speed range for a given horse-power to be exerted throughout that range.

Mr. William Cooper, in his paper before the Cincinnati Chapter of the American Institute of Electrical Engineers, subject "Methods of Speed Control," volume 20, No. 4, presents a method for determining the exact horse-power and speed rating of a motor in which can be combined to the best advantage field control and Multi-Voltage control in order to cover a given speed range with a given minimum horse-power.

I would refer you to Mr. Cooper's paper, which can be obtained by application to the Secretary of the Cincinnati Chapter of the American Institute of Electrical Engineers, Norwood, Ohio, for a full description as to the use of his methods. In presenting his paper, Mr. Cooper has stated the following interesting deductions:

1—The total range of speed using both variable voltage and field regulation will be as the square of the range of voltages.
2—Change of horse-power will be directly proportional to change of voltage on armature, field being constant.
3—Change of horse-power by change of field strength will be inversely proportional to change in speed, voltage on armature remaining constant.
4—The relative size of motor as referred to the maximum speed will be directly proportional to its speed variation when using variable voltages.
5—The relative size of motor as referred to maximum speed will be as the square of the speed variation when using field regulation.

Having the method to determine the exact range of speed that the motor is to cover in itself, it then simply remains to attribute the balance of the range to the mechanical device, and this may be accomplished by using one or two gears as may be necessary. The controller should have as many steps as will provide a speed curve having a geometrical development.

We have departed somewhat from our text in following the progress which enabled us to successfully apply the electric motor to the new shop methods, but, perhaps, I have been able to show that the same exact engineering has been applied in giving the maximum result for the minimum expenditure in the development of this feature of the new shop methods as has been applied in determining the operating and mechanical features of this new shop method, and all of which contribute to get the maximum result for the minimum expenditure from—

1—Fixed charges or general expense such as interest on investment, superintendence, etc.
2—Workmen's time.
3—Power required to operate plant.

The individual motor contributes the following collateral advantages quite independent of the other features of the new shop methods :

Clear overhead space, permitting the use of cranes, and giving improved light and ventilation.
Condensed shop space, because the tools can be set much closer when individually driven, than if operated by belts with counter-shafting.
Ease with which shop lay out can be arranged or rearranged, because the tools do not depend upon fixed lines of shafting, and can be readily moved from place to place.
A much lighter shop structure, because the side walls and ceilings do not have to support heavy line shafting.

I have not attempted to introduce engineering data to bear upon the matter herein discussed. It would take too long, and I would refer those who are particularly interested to the considerable matter that has already been presented to the American Institute of Electrical Engineers and Engineering Journals, etc., but suffice it to say that the individually-applied motor goes a long way towards enabling the new shop methods to place in the hands of the employer a means of discounting the demand of the labor union for shorter time and higher wages, which means consists of working his men and his tools at a far higher rate of efficiency, the ultimate result of which is a much greater output, despite the increase in pay roll and the shortening of the hours worked.

SOME POINTS RELATING TO SUBMARINE ELECTRIC POWER CABLES.

By G. U. G. Holman.

The sub-marine power cable belonging to the Canadian Electric Light Co., which supplies one thousand horse power to the Quebec Railway, Light & Power Co., in the City of Quebec, is laid on the bed of the St. Lawrence River, the terminal cable bells being approximately 3,400 feet apart.

A description of the laying of this cable was in the June, 1902, Convention Issue of the Canadian Electrical News, but as some of the audience may not have noticed in particular this article, I will say that we laid this cable amid floating ice conditions on December 18th, 1901.

The interruptions of service have taught a few lessons to us, as well as to the Cable Manufacturing Co., and it is these which I intend to mention in this paper.

This cable, which we will call No. 1, since we are now laying a second cable in the St. Lawrence River, is composed of four nineteen strand conductors, each of an equivalent of 2-0 solid copper. Each conductor is covered with a 40 per cent. Para rubber compound to the thickness of 4-32 of an inch, and then wrapped with one layer of 3-inch black, insulated, tape. The four conductors are twisted one revolution in four feet, about a common jute centre with four No. 14 B. & S. gauge, solid copper, rubber-covered wires, as pressure wires, laid-in between the four heavy conductors on the periphery of the cable. The whole was then covered with heavy rubber filled tape and served with two layers of tarred jute. An armor of thirty No. 6 B. W. G. galvanized steel wires was spirally laid over the cable.

The weak point was early shown to be the pressure wires.

One of the pressure wires open-circuited in June, 1902, six months after the cable was put in service. In August, 1902, a second one open-circuited, and in October of the same year a breakdown in the cable occurred which showed itself on one of the pairs of conductors—the cable being used for two phase transmission.

Upon minute examination of the break, which was much more difficult than would appear in the writing of this account, it was evident that a ground between the armor and one of the power conductors so weakened the insulation by virtue of the heating at that point of the rubber insulation, that a short circuit ensued between the two neighboring conductors.

Further, it is the opinion of Mr. Henry and Mr. Reed, the general superintendent and the construction superintendent respectively of the Canadian Electric Light Co., as well as my own judgment, that the insulation between the armor on one conductor was weakened by the continuous inductive spark at the point in one of the pressure wires where it had open-circuited. From a careful weighing of all the facts it is evident that overlooking the only have developed through the apparently insignificant fact of the minute sparking at such open-circuited point in the pressure wire.

The repairing of the cable at this point was effected, and the cable has been in successful operation since that time, except from a defect caused from what we term a mechanical cause, or a cause from the exterior of the cable and by ice, in contrary distinction to an internal electrical cause.

Although the engineer of the Cable Manufacturing Co. and the writer carefully discussed the question before the cable manufacture of the insertion of pressure wires in this cable, it was not deemed bad engineering at that time to place such wires in the cable under discussion. This engineer has had as much submarine cable experience as anyone in America, but he has learned something through the faults in our No. 1 cable, so that in placing the order last fall for a No. 2 cable, four flexible power conductors alone are in this No. 2 cable. We even discussed, at the time of placing the order for the No. 1 cable the question of placing the pressure wires in the centre of the cable rather than towards the periphery, but it was not at that time deemed unwise to place them in the peripheral position, but our experience shows that what we thought to be very unlikely actually did occur; that is, that it is a mistake in cable design to place the pressure wires on the outside of the larger conductors where such small wires would be subjected to greater mechanical movement than in the centre of the cable, and that even if they had been placed in the latter position, there is too much danger of their causing trouble to the insulation of the larger conductors.

Of course it can be theorized that had we made the No. 14 solid pressure wire of strands of wires we would not have had the breakdown, owing to the break that we did have, possibly occurring at the point where the solid wire was jointed by an electrical weld.

The greatest danger in future with our cables in the St. Lawrence River, and in fact any rivers of this northern climate, is from the ice conditions in the spring of the year. It is, consequently, absolutely essential to not only protect the shore ends from the action of the ice grinding against the cable itself near what would be the surface of the river, but to protect the cable as it lays on the river bottom where the cable approaches the shore ends. This has been shown by some experience that we have had and that experience has taught us that in laying up the cable to the shore end where is, as may be expected, the greatest movement of ice down river, we should approach the shore within several hundred feet at a point about the same distance down stream and thence make a detour of the cable towards the terminal point. The river depth at such a distance from the shore is invariably greater than nearer the shore. As the ice catches on the bottom of the river and rotates huge cakes no damage is likely to ensue if the line of the cable be in the general direction of the movement of the ice. The overturning cakes of ice will not tend to catch in the cable as they would if the cable be laid at right angles to the direction of the flow of the river, and, where it does cross at right angles, it would lay at a point considerably below the surface of the river where the ice will not touch the cable.

The cable bells, or ends, which we have used have proven very satisfactory and are merely brass tubes five inches in diameter with 1-8 inch walls brought down to a conical shape with a small hole of the size of the exterior of the cable, the tube being two feet long and flanged, or belled for an inch. So that with this cable end slipped over the cable and the insulation compound melted and poured in the bell is completely filled between its walls and the four conductors separated as far as possible at equal distances from each other and about one inch from the mouth of the bell, the insulation compound, ozokorite, being brought to the top.

I will say that in our method of laying this cable on the two occasions that we have done so, we have had the use of a special large reel capable of holding it entirely. The reel is on trunnions geared about 10 to 1 to cranks on each side of the reel, which are moved by man power.

Our experience shows us that it is essential to lay the cable slowly in order to be sure and follow every indentation in the river bed, as, in the drop of 170 feet, which is the depth at some points of the St. Lawrence River where our cable is situated, more time is necessary for the cable to be laid on the bottom of the river than what, at first thought, might be considered possible.

Briefly, our experience is to never put conductors of materially different sizes within the same armored cable, and also to be very careful, in our climate, of the shore ends.

The No. 2 cable, which we are about to lay, has nearly twice as heavy armor as the No. 1, as it will have No. 4 B. W. G. instead of No. 6 B. W. G. galvanized steel wire spirally served on the cable, as in the river between Quebec and Levis there are four other cables of the telegraph and telephone companies, and as the gentleman who assists us in our cable laying operations has charge of similar work for the telephone and telegraph companies, we are able to say that the problem of laying a 100 pair telephone cable is a different proposition from laying a two-pair cable of an electric power company, weighing seven pounds per foot.

For protection against static discharges, and lightning entering the cable to ground, we are using G. E. lightning arresters on each conductor, and with success.

One effect of cable transmission is very noticeable and that is the smoothing out of the voltage variations. The output end of the cable presents a smoother record curve than the in-put end. The cable is a condenser into which energy is pushed and the surplus energy overflows.

We also find a curious inductive effect, producing 1,300 volts on opposite leads of the two phases, although there is a difference in voltage between phases of 2,200 volts.

In cable repairs we use pure Para rubber tape several inches wide and about 1-32nd of an inch thick. Also a mucilage made of pure rubber clippings dissolved in gasolene. The mechanical joints in the stranded conductors are made in the usual manner, but removed six or eight inches from each other along the cable length. The pure rubber tape is then laid on and the foregoing described mucilage pasted between the rubber tape layers. The insulation joint is so perfect that cutting it discloses a solid rubber covering.

The joints are then laid in together as are the cable conductors and wound with tarred jute. The armoring of a cable joint is the most difficult job mechanically, but the steel wires are intermingled for several feet and then tightly brought upon the cable by wrappings of smaller galvanized steel wires.

I know that there are some power cable installations in contemplation and if this paper suggests anything to the minds of those considering the subject, or, if I am able to answer any questions presented by members or friends of the Canadian Electrical Association, I shall feel more than repaid for my slight effort in presenting this paper in which Mr. Henry and Mr. Read of the Canadian Electric Light Company have had a hand.

SINGLE PHASE MOTORS AS A MEANS OF INCREASING STATION EARNINGS.

By W. A. Layman.

An electrical central station with its auxiliary distribution system, is a manufacturing plant, and the same general principles of operation apply to it as to any other form of factory. There must be the greatest possible simplification of output; production must be maintained on as nearly uniform basis as possible; and the full productive capacity must be sold, if possible. Economical operation of central stations is therefore inevitably drifting toward the ideal basis of generation of one form of current, and the development by every means possible, of a high load factor. Further than this, operating engineers are specifying the installation of consuming devices, which afford the lowest first cost, and the simplest possible system of distribution. The single phase alternating current motor lends itself readily to the development of this general scheme of economic production in ways it is the purpose of this paper to briefly set forth. The following concise statement of facts will be accepted—the writer believes—by all central station men who are familiar with the performance of the single phase alternating current motors, as built by the Wagner Electric Mfg. Co.

1st. The single phase motor has reached a high stage of mechanical and electrical development, and is to-day thoroughly reliable for all kinds of power service, not involving frequent starting and stopping, and speed variation.

2nd. The average single phase motor is equal in its electrical characteristics to the average polyphase motor.

3rd. The single phase motor calls for no larger degree of inspection and maintenance expense than the polyphase.

4th. The operating engineer of a large alternating current station would prefer an equipment of polyphase generators, with single phase distribution system, for service of all kinds, if possible. Difference of opinion exists between operating engineers of polyphase plants as to the extent to which single phase distribution may be judiciously employed, based upon the results obtainable with single phase motors.

5th. The operating engineer of a small station would prefer single phase generators, and single phase distribution exclusively.

The writer of this paper is an advocate of the following arrangement of station service:

(a) For large plants. Polyphase generators, with switchboard arranged for operating:

1st. Polyphase feeders for all large power and rotary converter service.

2nd. Single phase feeders for all general lighting service, and for all small power work, the switchboard facilities being such that any single phase feeder may be switched to either phase of the generator busses.

3rd. Independent feeder regulators for all polyphase as well as single phase feeders.

(b) For small stations. Either polyphase generators with single phase feeders, which may be thrown by the proper switchboard devices to either phase of the generator, and each feeder with independent pressure regulator; or single phase generators, with single phase feeders, each feeder being operated with independent pressure regulator.

This policy with respect to station and distribution equipment is advocated on the conviction that the single phase motor has come to stay, and that it affords an alternating current central station—polyphase or single phase—the ideal means of distributing small power. There may be a difference of opinion between the writer and central station engineers as to the scope of the term "small power," but in the writer's belief it is a generally conceded fact that the single phase motor is the central station man's best instrument to economical power service up to units of a certain magnitude. The writer believes single phase motors should receive preference of the operating engineer of multiphase stations, up to units of at least 15 H.P. capacity, and, in selected instances, up to units of even 35 H.P. capacity. The limit of size is fixed naturally by the unbalancing effect produced between phases of the polyphase system. Polyphase stations of the writer's knowledge are successfully operating single phase motors of 35 H.P. Single phase stations with individual generators not exceeding 75 K. W. capacity, are also successfully operating with single phase motors of 30 H.P. each.

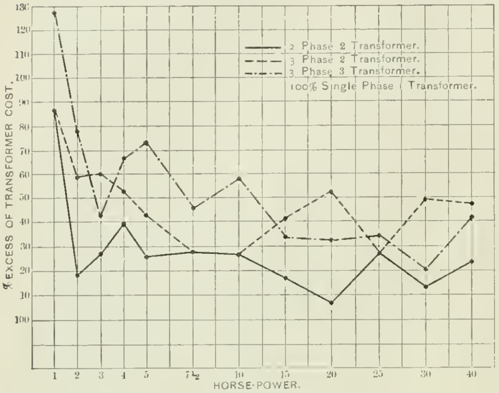


Fig. 1.

Curves showing excess of first cost of transformers for multiphase motors as compared with single phase.

(These curves are based on price list of one of the large companies.)

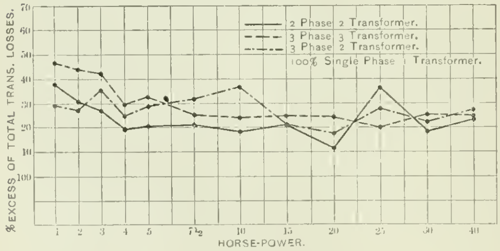


Fig. 2.

Curves showing excess of transformer losses for multiphase motors as compared with single phase.

The justification for the use of single phase motors by polyphase plants arises from the lower first cost of individual power installations, and also the higher efficiency in small units of these installations. As illustrating the high first cost in step-down transformers alone, for polyphase motors, as compared with single phase motors, your attention is called to Fig. 1, and as illustrating the high core losses of step-down transformers for polyphase motors, as compared with single phase motors, your attention is called to Fig. 2.

The curves in these two figures are plotted on the basis of standard sizes of step-down transformers now prevailing, and the sizes of transformers required under the various conditions of service are those shown in the following table:

TRANSFORMERS REQUIRED

H P of Motor	Single Phase	2-Phase 2-Trans.	3-Phase 2-Trans.	3-Phase 3-Trans.
1	1-1 KW	2- .6KW	2- .6KW	3- .6KW
2	1-2 "	2-1. "	2-1.5 "	3-1 "
3	1-3 "	2-1.5 "	2-2 "	3-1 "
4	1-4 "	2-2 "	2-2.5 "	3-1.5 "
5	1-5 "	2-2.5 "	2-3 "	3-2 "
7½	1-7.5 "	2-4 "	2-4 "	3-2.5 "
10	1-10 "	2-5 "	2-5 "	3-4 "
15	1-15 "	2-7.5 "	2-10 "	3-5 "
20	1-20 "	2-10 "	2-15 "	3-7.5 "
25	1-25 "	2-15 "	2-15 "	3-10 "
30	1-30 "	2-15 "	2-20 "	3-10 "
40	1-40 "	2-20 "	2-25 "	3-15 "

When the increased cost of polyphase line construction is taken into consideration, there becomes quite evident a material advantage for the single phase motor, even though the first cause of the motor, as compared with a polyphase motor of the same size, may be somewhat in excess of the polyphase motor. There is a rapidly developing tendency toward the installation of single phase motors, on polyphase stations, and as the possibilities of the single phase motor as to-day built are becoming better understood, it is the writer's opinion the use of single phase motors will grow with even greater rapidity. An instance recently occurred in which the contracting department of a large company agreed to supply polyphase current for 50 1-2 H.P. polyphase motors to be located in retail stores at isolated points on the distribution system. Each motor required an equipment of two step-down transformers. Upon installing the first motor it was found the idle transformer losses exceeded the effective load on the motor, and it is needless to say the operating department declined to carry out the contract made by the contracting department, and insisted upon the substitution of single phase for the polyphase motors.

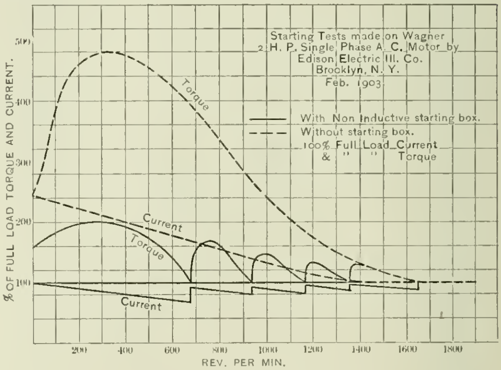


Fig. 3.

Great development has been made in the application of single phase motors by using non-inductive starting boxes for holding down the starting current. These boxes conform in general character to the usual direct current motor controlling rheostats. By their use motors of larger capacity may be used judiciously without injurious unbalancing effects on polyphase systems. The single phase motor built by the Wagner Electric Mfg. Co. possesses a starting torque characteristic when starting rheostat is not used, as illustrated in the broken curve in Fig. 3.

Instances are exceedingly rare where torque of this great magnitude is necessary to successfully start the load. Therefore a starting rheostat may be used and starting current held down to a low limit without sacrificing the necessary starting torque required for the usual installation. Fig. 3 illustrates a test made by one large company, in which full load torque was maintained from rest to full speed, without the current exceeding at any time the full load current. This is a better result than will be developed by the average motor, the manufacturers of the Wagner motor not claiming to be able to start full load torque in much less than 125 per cent. of full load current.

It is not necessary to dwell at any length upon the desirability of actively canvassing for motor load. Canadian stations are perhaps in advance of the average American companies in having for a number of years endeavored with great activity to secure a large load factor. The writer therefore believes that the operating engineer attending this convention will, without entering into the discussion in greater detail, accept this statement—that the single phase motor affords an exceedingly useful adjunct to the development of larger station earnings, by not only taking care of one form of business, which it has hitherto been difficult to take on, namely, the isolated power customer—but also by enabling the handling of a larger power business, even in the concentrated business districts at a lower first cost of installation, and therefore on the basis of a larger percentage of profit per horse power installed.

In concluding this paper, and for the benefit of those who are not especially familiar with the Wagner single phase motor, a description of that motor may prove of interest.

A great amount of time and thought has been devoted to the production of a commercially successful single phase motor. Early efforts to produce such a motor were broadly confined to two characteristic types—the synchronous motor, and second, the direct current motor, slightly modified to operate on alternating current. These efforts proved futile and no large degree of success in the production of a single phase motor was attained until the present form of induction motor, built by the Wagner Electric Mfg. Co. was placed upon the market. The motor consists essentially of a primary or stationary element, commonly referred to as the "field," and a secondary, or revolving element, commonly referred to as the "armature." These elements are entirely independent of each other. The current from the source of supply is fed into the field, and this induces all currents set up in the armature windings. In general terms, the armature may be said to be of the well-known direct current form, a progressive winding being connected to a radial commutator in the usual direct current armature fashion. Brushes are provided which, under usual circumstances, are short-circuited through the rocker arm, carrying them. In addition to these brushes there is placed within the annular opening of the commutator a short circuiting device, centrifugally controlled, the purpose of which device is to completely short-circuit the commutator, and through the commutator, the armature windings, when the armature has attained a predetermined speed of rotation. The motor is designed to operate in two distinct ways. First, with one combination of elements at starting, and second, with another combination of elements in the running condition. In starting, the induced currents of the armature windings are given a directional control through the brushes which results in a rapid accelleration of speed, up to what may be termed the normal operating speed. At this point the centrifugal device comes into play, forcing the short-circuiting links into the annular commutator opening. Simultaneously the brushes are removed from the commutator, and thereafter the armature revolves, performing its function in a mannèr quite similar to the ordinary polyphase motor. The motor is shown in cross section in Fig. 4.

The perfection of mechanical and electrical design of this motor is evidenced by its successful operation over a period of a number of years on almost all the leading central station systems of distribution. That the commutator arrangement meets satisfactorily the requirements of the service is evidenced by the fact that the Wagner Company has been building this form of motor for almost six years, and has not supplied up to the present time more than half a dozen renewal commutators, and this limited number of commutators was supplied to a single customer, who had installed a number of 30 H. P. motors to perform a special service involving an enormous number of stoppages daily.

At a number of conventions enquiry has been made as to the number of motors small stations can successfully operate. Instances are on record as follows:

One station, having a 75 K.W. generator has installed 100 H.P. in single phase motors. Another with 180 K.W. in generators, has 140 H.P. in single phase motors, and a third with 75 K.W. generator capacity, has 45 H. P. in motors. This form of motor adapts itself to all the usual kinds of small power work, such as pumping service, air compressors, printing presses, blowers, and small factory driving, coffee mills, belted elevators, storage battery charging, through the medium of motor-generator sets, etc. The type of single phase motor built by the Wagner Electric Mfg. Co. at the present moment is limited in application in only two ways, first, in the handling of work requiring a variation of speed, and second, in the handling of work calling for a great number of starts daily.

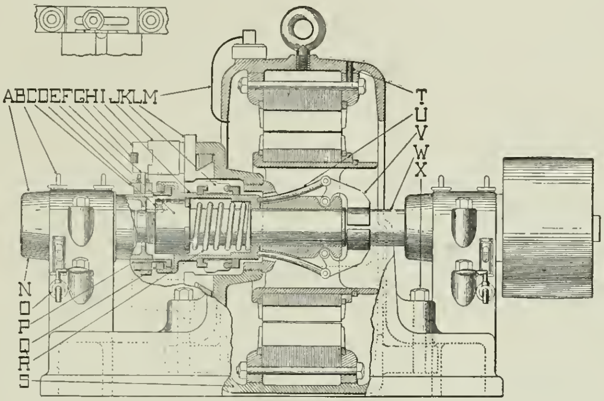


Fig. 4. Cross Section Open Type Motors.

A—Pillow Block Cap.
B—Oil Cover.
C—Rocker Arm.
D—Spring Nut Key.
E—Spring Nut.
F—Adjustment Stud.
G—Brush Holder Spring.
H—Carbon Brush.
I—Spring Barrel.
J—Brush Holder.
K—Short Circuiting Ring.
L—Commutator.
M—Terminal Cable.
N—Pillow Block.
O—Oil Cock.
P—Rocker Arm Tube.
Q—Spring Barrel Ring.
R—Govern or Spring.
S—Field Clamp.
T—Dowel Pin.
U—Goveruor Weight Pin.
V—Governor Weight.
W—Shaft.
X—Strap Bolt.

HIGH TENSION TRANSFORMERS.

BY J. W. FARLEY.

In a complete high voltage electrical power installation there are three distinct elements. These are: 1st, The generating plant; 2nd, the transmission line with its raising and lowering transformers; and 3rd, the apparatus for the distribution and application of the transmitted power.

Each of these divisions has its peculiar problems which must be met and solved, and each has its own special features. The first and third—the generating and distributing elements—have received more attention, perhaps, than the second—the transmission system. This is doubtless due to the fact that the rules and precedents governing the construction of a complete high tension system are not so well codified and as thoroughly understood as is the case in most other branches of electrical engineering The high tension installations already in successful operation have been designed and built by busy men who have not found time to lay before the public the valuable experience which they have acquired.

The present transmission line, with its raising and lowering transformers, constitutes the link between the generator, which may be located at some place where power is cheap, and the motor or rotary converter situated at the point where the energy is to be utilized.

It is axiomatic that with a given cost of conductor and a given loss the distance to which power can be transmitted depends upon the voltage. To raise the voltage to the figure demanded for economical transmission, and then to lower it to a pressure adapted for rotary converters, motors or lights, is the function of the high tension transformer, and it is on this account that it plays so important a part in the consideration and design of a long distance system of transmission.

The great progress in electrical power transmission which has occurred in the past few years is due in a measure to the advance made in the science of designing generators and motors and in the art of manufacturing them. It is, however, the development of the transmission system itself and especially of its high tension transformers which is the criterion of the great advance now being made in the electrical field.

In 1891 the company with which I am associated furnished transformers for the first long distance transmission installation in America. This was a 10,000 volt system between Pomona and San Bernardino, Cal. The groups of raising and lowering transformers were made up of twenty separate units, each wound for a high tension voltage of 500, the high tension windings being connected in series for 10,000 volts. The object of this was to divide the full voltage among many units, in order to insure adequate insulation between the coils and ground was obtained by heavy wrappings of insulating material and by the use of oil.

In 1895 experiments were undertaken on a high tension transmission line installed at Tulluride, Colo. Voltages as high as 60,000 were used and a great deal of valuable qualitative data was obtained. These tests were continued later upon an experimental high tension line at the Westinghouse Company's Works, East Pittsburg, when a long and careful series of measurements was made under varying conditions.

The manufacture of high tension transformers has been going on continuously for several years and on the whole so successful has been their operation and so marked have been the improvements in the design and construction of the higher voltage transformers, that to-day consulting engineers and prospective builders of transmission lines have become accustomed to the use of voltages of 40,000 and 50,000, and are seriously considering voltage as high as 60,000. No little confidence, of course, has been established by the successful operation of several high voltage systems in the West, notably the plant of the Missouri River Power Company, which transmits energy at 50,000 volts from Canyon Ferry to Helena and Butte, distances of 17 and 65 miles respectively.

Mention is so frequently made to-day of transmission at voltages in the vicinity of 50,000, and so many projects are being planned which embody transmission lines of approximately this voltage, that the successful inauguration early this year of a 50,000 volt line almost one hundred miles in length did not attract the attention it would have done even twelve months ago. I refer to the transmission system of the Shawinigan Water and Power Co., extending from Shawinigan Falls on the St. Maurice River, P. Q., to Maissonneuve, a suburb of Montreal. Since the middle of February this line has been delivering energy generated at Shawinigan Falls to Montreal, ninety miles distant, at a pressure of 50,000 volts. From the time this line was first thrown into service no shutdowns whatever have occurred.

The generating plant and the transmission line each merit detailed description. It is the purpose, however, of this paper to describe only the transformers as typical of the latest and best engineering practice in the design of high tension apparatus.

The raising transformers are designed to step up from the generator pressure, 2,200 volts two-phase, to 50,000 volts three-phase. The lowering transformers step down from 44,000 volts three-phase (allowance being made for a line drop of 12 per cent.) to 2,400 volts three-phase, two transformers being connected in "T." Taps for 86.7 per cent. are provided in both the high tension and the low tension windings; since two transformers connected in this way have a slightly higher efficiency and a better regulation than they would if connected either in "V" or in "T" with the full windings of both transformers in use.

No reference has as yet been made to the capacity of either the raising or lowering transformers. In the rating of these units lies one of their special features, well worth mentioning at this time.

The generating plant at Shawinigan Falls was designed with the idea of furnishing power at 2,200 volts to industrial establishments in the immediate vicinity. For the power service contemplated a frequency of 30 cycles was chosen.

When the plans for the transmission lines to Montreal were made it was decided to use the 30 cycle generators already installed, transmitting at that frequency and changing at Montreal to the frequency in use there (60 cycles) by means of motor-generator outfits. Future contingencies were, however, kept in mind and it seemed advisable to have the high tension transformers so built that at a later date, if desired, 60 cycle generators could be installed at Shawinigan Falls and the company's Montreal customers supplied with 60 cycle current direct from the secondaries of the step-down transformers. In fine, the transformers were to be designed for operation at either 30 or 60 cycles.

This was done in the following manner: A design was made for a 30 cycle transformer of the specified capacity (1,110 K. W. for the raising and 1,000 K. W. for the lowering), the characteristics being such that high efficiency and good regulation would be obtained. Both high tension and low tension windings were made in two equal parts, with terminals arranged for either series of multiple connection.

For 30 cycles the windings were designed to be connected in series. For 60 cycles, however, the two parts were to be connected in multiple, the same voltage being applied to but half the number of turns. The result of this is that while each part will carry the same amount of current as with the 30 cycle connection, the two parts together will deliver twice the amount of current with the same copper loss and at the same voltage as before, thereby doubling the capacity of the transformer.

Thus while the raising transformers have a capacity of 1,110 K. W. for 30 cycle operation, they are rated at 2,220 K. W. for 60 cycles and the lowering transformers are likewise rated at 1,000 K. W. and 2,000 K. W. for 30 and 60 cycles respectively.

Operating at 60 cycles the transformers will deliver their rated output (2,200 K. W.) with an ohmic drop only one-half of that for full-load at 30 cycles. The inductive drop will be the same under either condition. The regulation, therefore, at 60 cycles is better than at 30 cycles, the exact figure in the case of the raising transformer being for loads having a power factor of 100 per cent. the extremely low value of 0.376 per cent.

With the number of cycles increased by 100 per cent. and the number of effective turns decreased by the same amount, the flux density in the magnetic circuit will be the same, the loss per cycle being slightly more at the higher frequency than at the lower. The iron loss is, therefore, a little more than double at 60 cycles. Its percentage value, however, is increased but very little. The accompanying efficiency and regulation curves will show clearly the effects of the different arrangements upon the performance of the transformer.

In the preliminary consideration of these transformers, there was but little choice concerning the general type to be employed. With the construction used at present in the air blast transformers, the limit of its voltage is in the neighborhood of 25,000 or 30,000. The oil-insulated transformer, however, has been built for voltages far in excess of those now in commercial use, so that the voltage of transmission lines of the future will not be determined by the limitations of the transformers.

For voltages above 30,000, then, we are safe in saying that the feature of oil insulation is essential. For transformers of small capacity the cases may be designed with a surface of such an area that natural radiation will keep the temperature of the transformer at some conventional figure. The cost of this radiating surface increases, however, as a high power of the increase in capacity, so that for large transformers recourse must be had to artificial cooling of some kind.

In the Shawinigan transformers the heat is removed from the oil by means of the conventional cooling coils, through which water is circulated. These coils are of brass tubing and have no joints nor connections of any kind inside the case, so that the danger of leaks is reduced to a minimum.

The Shawinigan transformers are placed in an upright position in boiler iron cases. A more detailed description of these cases will be given later. Both high tension and low tension leads are brought out through the case iron tops, long specially made tubes of fullerboard and mica being used for the high tension conductors.

The coils of these transformers are wound up in sections of only one turn per layer. The turns are well insulated from each other and the several coils and sections are protected by wrappings and washers of heavy insulation. A very generous provision is made for ventilating ducts between the sections and between the laminae of insulations. There has been a tendency in the design of some transformers to overlook the fact that there are losses generated in the insulation and that in high tension transformers some provision must be made to dispose of the resulting heat. Careful attention was given to this point in the transformers in question and the insulating material, as well as the copper itself, is kept at a temperature only slightly higher than that of the oil. This point was proved by careful exploration with thermometers during the tests.

The ducts through the windings are vertical, so that when a transformer is operated a pronounced chimney effect is produced, the oil rising to the top with such a velocity that the surface of the oil is visibly disturbed.

The iron laminations are also separated at frequent intervals by ventilating ducts, which permit the oil to circulate to within less than an inch and a half of every part of the magnetic circuit.

The low tension leads from the coils are brought direct to a heavy marble terminal board, so arranged with studs and connectors that the somewhat complicated combinations referred to earlier can be easily and quickly made.

The terminal board for the high tension leads presented a more difficult problem; its solution was found, however, in the use of standard porcelain insulators mounted on pins and cross arms. Since the insulators are under oil a compact arrangement was effected which has the merit of making this one of the strongest points in the transformer.

The cases of all these transformers are provided with sight gauges at the top to show the height of the oil level. Gauges are also placed at the bottom of the case in order that the presence of water may be detected.

A thermometer is furnished with each transformer, its bulb extending into the oil just below its surface. This thermometer has electrical contact devices, whereby an alarm may be sounded in case the temperature of the oil exceeds any predetermined value.

Too little attention has ordinarily been paid to the consideration of adequate means for handling large transformers. In some instances no provision is made, a great deal of temporary rigging being required in order to install the transformers or to remove them from their cases for inspection or repair. Sometimes a travelling crane is provided which renders the lifting of the transformers very simple. Both the temporary lifting device and the crane, however, interfere very seriously with any high tension wiring which may be located above the transformers. Inasmuch as the logical position for the high tension wires is overhead, any method of handling the transformers which will not interfere with this wiring or which could be employed while the wiring is alive, is of decided advantage.

Each of the Shawinigan transformers is placed upon a heavy cast iron base which normally rests upon six flanged wheels let into the foundation proper, cast in the bottom of the base.

In front of the transformers parallel with the line in which they are placed is a track on which is a shifting or transfer truck supplied, in addition to the four wheels on which it moves, with six wheels placed in exactly the same manner as those on the transformer foundation. When for any reason a transformer is to be removed from its case, the truck is run up directly in front of the transformer, from which the leads and piping have been disconnected. The transformer, moving easily on the fixed wheels, is then pulled out on the truck. The truck and transformer may then be moved to a point beneath a permanent hoisting device.

If a travelling crane has been installed for other apparatus in some other part of the building, the above scheme can ordinarily be employed to bring the transformer within range of this crane.

A novel feature was introduced into the design of these transformers which lessens to a great extent the risk to surrounding property from the presence of the quantities of oil in which the transformers are immersed. This scheme, which was suggested by Mr. R. D. Mershon, involves the safe and rapid transfer of the oil to a place of safety in case of fire in the transformer building.

The transformer cases are made of heavy iron. The top is of cast iron, heavily ribbed and arranged to bolt to the tank, an air-tight joint being effected by means of a lead gasket. The manholes in the top are also made with air-tight joints, and all the leads and cooling coils are brought out through the stuffing boxes. At the bottom of the tank is placed a large valve which connects direct with the water mains. If a fire occurs in or near the building in which the transformers are housed and apprehension is felt lest their cases be damaged and the oil be ignited from the heat of the burning building, the emergency water inlet valve may be opened and the oil forced out of the top of the transformer into the sink hole. In this place it will be safe from destruction and the danger of great damage to surrounding property through the release of hundreds of gallons of burning oil will be averted. The substantial construction of the case, together with the water which will then fill it, will protect the transformer itself from harm, the only damage liable to occur to the transformer being the wetting which it will receive. A wet transformer, however, may, by proper treatment, without any great difficulty, be put again into condition for operation.

In the construction of large high tension transformers many serious problems are encountered. In addition to the difficulties incident to the winding and assembling of large coils, and the care which must be exercised in handling the quantity of insulation required, the question of keeping the insulation in good condition during manufacture, shipment and installation is perhaps one of the most important problems. The presence of moisture is fatal to the insulating properties of the best material which can be obtained. Even with the utmost care during manufacture, a certain amount of moisture invariably finds its way into the insulation. Some method must be devised then to thoroughly remove this before the transformers can be in the proper condition for operation.

Inasmuch as it is inadvisable and impracticable to ship large units in their cases and under oil, the plans for removing this moisture must comprehend the drying out of the transformers at the point of installation and immediately before the oil is placed in the cases.

A striking example of this was presented by several of the transformers shipped to Montreal and to Shawinigan Falls. These transformers left the States in December, arriving in Canada at one of the coldest periods of the winter. Before they arrived at their destination the weather suddenly moderated and the atmosphere was heavily impregnated with moisture. The transformers were, however, at a temperature many degrees below freezing point and on being unpacked were found to be entirely covered with a white frost to a thickness of from 3-8 to 3-4 inches. The weather continuing warm, this frost gradually melted, leaving a considerable amount of water throughout the transformers.

The manner in which these transformers were successfully dried out will no doubt prove interesting at this time.

As soon as possible the transformers were placed in their cases without oil and the tops put in position. The low tension windings were short circuited through the high tension windings. Thermometers were placed at those points which might be expected to develop the highest temperature under these conditions of heating. These thermometers were very carefully watched and the current was so regulated that the actual maximum temperature remained in the vicinity of 100 degrees C. At this temperature both oil and water vapors were thrown off in great quantities.

Energy at 500 volts direct current was available and electric heaters, accommodated to this voltage, were designed and made. These heaters were enclosed in sheet iron boxes and connection was made between them and an opening at the bottom of the transformer case by means of ordinary stove pipe. The heaters delivered to the transformers a great volume of air heated to a temperature of almost 200 degrees C. Baffle plates were placed inside the transformer cases so that the hot blast might not blow directly against either the coils or the insulation.

The hot air rose from the bottom of the case to the top, pouring out of an opening left in the cover. This circulation of hot dry air tended to remove from the inside of the case the vapors expelled from the interior of the transformer by the heat generated there.

This process was continued for several days. Measurements of the insulation resistance were taken from time to time until the results showed that the transformers were in even better condition than they had been when they successfully underwent the puncture and over-potential tests of 100,000 volts.

While the transformers were still hot the oil was placed in the cases and an increased current circulated through their windings. The quantity of this current was such that the heat generated in the windings was sufficient to maintain a fairly vigorous circulation of oil through the interior of the transformer.

No trouble was encountered in bringing the transformers up to full voltage for the first time and nothing has since arisen which indicates that the insulation is in any other than first-class condition.

This paper would not be complete without at least a reference to another important Canadian power transmission. The Montreal Light, Heat and Power Company transmits power from its generating plant on the Richelieu River to Montreal, eighteen miles distant, at 25,000 volts.

These transformers have the greatest capacity of any transformers ever built, namely, 2,750 K. W. The step down station of this line is in the heart of the city of Montreal, and owing to city ordinances prohibiting the storage of quantities of oil within the city limits, the air blast type was chosen.

These transformers are of the same general construction as the Shawinigan, except of course that they are not placed in cases, but are provided with a neat cast iron housing. The air is forced through ducts placed between the coils and between the iron laminations in a manner analagous to the natural circulation of oil through the ventilating ducts of an oil-insulated transformer. The amount of insulating material used is, of course, greater than in transformers of the oil type designed for the same voltage.

Up to the time of the unfortunate accident to the dam at Chambly these transformers and the transmission line gave a service highly satisfactory in all respects.

In bringing this paper to a close it may perhaps be no more than fair to say that the special emphasis laid upon the transformers of the Shawinigan Water & Power Company is due to the fact, not generally realized, that the Shawinigan transmission system stands as chief of the three most prominent long distance, high voltage systems in the world, exceeding one of them in voltage and one in length of line; and to the fact that these transformers present the latest and best features, electrical and mechanical, of good transformer design.

BOILER INSPECTION.

The last annual report of the Inspector of Factories for Ontario contains the following chapter on "Boiler Inspection," over the signature of Mr. James T. Burke:

Thorough boiler inspection is only possible under government supervision; while we have some powers under Section 20 (g) of the Ontario Factories Act, yet we occasionally receive reports of boiler explosions which do not apply under the Act. A boiler explosion usually carries with it a loss of life, as well as destruction of property, and I would recommend that the law be so amended that all boilers in the Province of Ontario be inspected and tested by some authorized representative persons, who will follow the modern practice of ascertaining whether boilers are safe in places which do not come under Section 20 of the Factories Act or the Boiler Inspection Company of the province.

Boiler inspection is usually regulated under the following order:

No. 1. Hydrostatic tests.
No. 2. External inspection.
No. 3. Internal inspection.

Mr. J. J. Wright,
President Canadian Electrical Association.

The Hydrostatic tests consist in applying a cold water pressure to a boiler that is completely filled with water, after which the inspector looks the boiler carefully over in all parts to see if there are any signs of leakage, or distress of any kind. This test is usually applied to new boilers or boilers that have undergone extensive repairs. This test is not considered to be injurious to a boiler when it is applied by a man with good judgment. The hammer test is recommended also when it can be applied.

External boiler inspection is made by looking the boiler over from outside to make sure that the attendants are not running it at a higher pressure than is allowed, that he is carrying plenty of water in the boiler, that the safety valve will blow off freely and at the pressure it is allowed, that the water gauges are in safe condition, that the boiler is not showing any signs of leakage or any bulges over the fire sheet, or signs of distress of any kind.

Mr. K. B. Thornton,
First Vice-President Canadian Electrical Association.

Internal boiler inspection, or hammer tests, as they are sometimes called, is made by the inspector entering the boiler through the manhole and looking the inside over carefully as well as the outside of the boiler. Among the things that he has to look out for are these: A deposit of sediment or muddy matter, hard incrustation or scale on the tubes and plates, corrosion of any part of the boiler, both inside and outside fractures of the plates, heads, headers, etc., leakage around the tube ends, seams, and all other places where such leakage is possible, defective bracing of the flat parts of the boiler, grooving of the plates or heads, burned or blistered parts, defective accessories of all kinds, water gauges, feed pipes, blow pipes, steam pressure gauges and safety valves.

Mr. A. A. Wright,
Second Vice-President Canadian Electrical Association.

We frequently find that a steam gauge has not been tested for several months, which is wrong on account of the delicacy of its construction; a great deal depends upon its accuracy. Moreover, safety valves are sometimes found weighed down with scrap material, and they occasionally stick, when it is difficult to tell whether the gauge or pop is correct. Such incidents as these help to explain some of the unaccountable boiler explosions, which upon subsequent investigation have shown neither low water nor bad stay-bolts. Owners should purchase the very best steam pressure gauges which is the general practice, and they should be tested frequently while in use. With the gauge correct, the safety pop valves should be frequently set, and any sticking should receive prompt attention

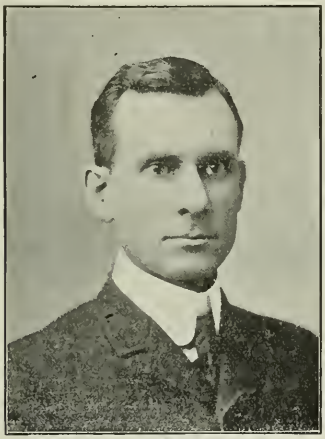
AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The twentieth annual convention of the American Institute of Electrical Engineers was held at Niagara Falls, N. Y., from June 29th to July 3rd. Not only was there a record attendance, but the whole week was a continual round of business and pleasure combined. Over five hundred of the foremost electricians on the continent registered in the first two days alone. Representatives were present from Great Britain, France, Belgium, Germany and Canada.

The headquarters of the convention were at the Cataract House, whilst the various business sessions were held at the Natural Food Company's Hall.

The large number of distinguished men present included representatives from Cornell University, the University of Illinois, Iowa State College, Lehigh University, University of Missouri, Ohio State University, Pennsylvania State College, Purdue University, and the Western University of Pennsylvania. Cornell and Purdue were in special evidence.

The first included an address from the President, Chas. F. Scott, of Pittsburg, addresses of welcome from the Mayor and local bodies : papers on Institute branch meetings ; energy transformations in the Synchronous Converter, and commercial alternator designs, with exhaustive plans and blackboard illustrations sketched upon the spot by the leading men in their line.



Charles F. Scott, Pittsburgh, Pa.,
President American Institute Electrical Engineers.

In the afternoon the Niagara power houses, the historic Falls and Rapids, and the various points of interest were visited. An exhibition of the Hewitt Converter and the Mercury Vaper Lamp, was given in the evening by Prof. Thomas. This was a wonderful demonstration of several things made public for the first time. A female brass band and orchestra enlivened the proceedings.

Tuesday was Electric Railway day and confined principally to railroad papers given by the leading experts, including high speed problems, storage battery industrial locomotives, predetermination in railway work, car run tests, electrical and mechanical specifications for trolley line insulators, the storage battery in sub-stations, and operation of railway motors in service.

In the afternoon a technical tour of inspection was made of the electro-chemical and other electrical installations operated by Niagara power, with a grand reception and luncheon given by the Niagara Power Company. In the evening a dance was held at the Cataract House.

The papers for discussion on Wednesday were on the test of electrical apparatus for dielectric strength, choice of frequency for very long lines, methods of bringing high-tension conductors into buildings, Y or Δ connection of transformers, the grounded wire as a protection against lightning, the operation and maintenance of high-tension underground systems, electric cables for high voltage service and the use of automatic means for disconnecting disabled apparatus.

In the afternoon trolley trips were made to Niagara Gorge and Brock's monument, the evening being given over to a magnificent garden party and entertainment at the Cataract.

Thursday and Friday was a continuance of the valued papers and most thorough debate thereon. Technical trips by trolley and otherwise were taken also to see an illumination of the whirlpool rapids at night.

A feature of the convention was the ride along the river on decorated flat cars of the Niagara Falls and Buffalo line with stoppages at the various plants en route. J. R. H.

THE MONTREAL LIGHT, HEAT & POWER COMPANY.

According to the second annual report of the Montreal Light, Heat & Power Company, submitted at the meeting of shareholders on June 5th, the gross earnings of the company for the fiscal year ended June 30th, 1903, amounted to $1,937,560.57, and the net profits to $718,667.51. There were declared four quarterly dividends of 1 per cent. each, which left a balance of $39,333.51, which was placed to the credit of surplus account.

The Queen street station was during the year remodelled and made thoroughly fire-proof, thus reducing the cost of insurance.

Owing to the break in the Chambly dam the company suffered a loss in revenue and an increased operating expense estimated at $153,351.37. When the reconstruction of the dam is completed the company will have 1,600 additional horse power.

During the year 17,806 incandescent lamps, and motors equivalent to 5,093 horse power, were added to the company's circuits, exclusive of the companies recently acquired.

There were installed during the year 3,565 gas and 465 electric meters, 2,305 gas stoves and 1,338 new services, and 7.3 miles of new mains were laid.

The Dominion Government have granted incorporation to the Chatham, Wallaceburg & Lake Erie Railway Company, to construct an electric railway from Rondeau to Wallaceburg, with a branch from Charing Cross to Blenheim. The incorporators include George Stephens, N. H. Stevens, W. E. McKeough and William Ball, of Chatham.

The Electrical Development Company, of Ontario, Limited, are calling for bids for the construction of a wheel pit and two tail race branch tunnels at Niagara Falls. This company has been formed for the purpose of undertaking development work originally contemplated by the Toronto & Niagara Power Company. The wheel pit about to be constructed will be 480 feet long, 180 feet deep and 27 feet wide, cut through solid rock.

TRADE NOTES.

The Dominion Motor & Machine Company, Toronto, has been succeeded by Power Accessories, Limited.

The Eugene F. Phillips Electrical Works, of Montreal, have just opened a Toronto office at 50 Adelaide Street West, with Mr. J. P. Thompson in charge. The company intend to give greater attention to their western trade in future.

The R. E. T. Pringle Company, Limited, of Montreal, through their St. John branch, have been awarded the contract to equip the steamer Beatrice Waring with an electric light plant and search light. The plant will consist of an 11½ k. w. Crocker-Wheeler generator, which will supply the current for 110 lights and the search light, and a Leonard automatic engine.

The Westinghouse Traction Brake Company, 26 Cortland St., New York, has recently received from the St. Louis Transit Company, St. Louis, Mo., an order for from fifteen hundred to two thousand air brake equipments for street railway service. This is claimed to be the largest single order for air brakes for electric railway cars ever placed in the United States or abroad.

A novel application of induction motors is to be made by the Belleville Portland Cement Company in their cement plant at Belleville, Ontario, which is to be equipped throughout with Westinghouse electrical apparatus. A recent order placed with the Westinghouse Electric & Manufacturing Company comprises two 450-kilowatt, engine-type alternators, one 100 kilowatt, D. C., engine-type generator and a motor-generator set consisting of a 100 kilowatt, D. C. generator and a 150 horse-power, three-phase, type C induction motor. These two D. C. machines are to be used for exciting the fields of the A. C. generators, for supplying lighting circuits and for the operation of a tramway locomotive. Sixty-two induction motors will supply the motive power. These include forty-six type C constant speed motors, ranging in capacity from 10 to 50 horse power; ten type F, variable speed induction motors, each to be direct geared to a rotary kiln and provided with a controller permitting the operation of the motor at any one of four speeds; two type F motors, each to be direct connected to a hoist and provided with standard non-reversing hoist controller; also four 400 volt, type C variable-speed induction motors for the operation of two overhead travelling cranes, these being provided with reversible crane controllers. Included in the equipment is a Baldwin-Westinghouse mining locomotive for operation on a 24″ gauge track with double trolley. The ten-panel switchboard consists of two generator panels, three A. C. feeder panels, a double exciter panel, a D. C. feeder panel for the control of the tramway circuit and another to control the circuits of the generator fields, and two D. C. feeder panels for the lighting circuits. Altogether this will be a novel and interesting plant, as the operation of rotary kilns by direct connection to variable speed induction motors is a new departure from the usual method of supplying power to this class of machines.

NOTES OF THE C. E. A. CONVENTION.

The Bullock Electric company registered all in attendance, giving each a numbered button and a metal souvenir badge.

Everybody, and the older members of the Association in particular, were pleased to see at the C. E. A. convention the familiar countenance of Mr. C. F. Medbury, who is now with the Westinghouse Company at Detroit.

The Canadian General Electric Company gave away to the visiting members and ladies a beautiful souvenir badge in the form of a minature arc lamp attached to a red, white and blue ribbon. The demand for these novel souvenirs was very great.

Other invitations received were from the Chapman Double Ball Bearing Company and the Henderson Roller Bearing Company, both of which had special exhibits prepared for the Convention, which were visited by a large number of the street railway men, who saw in these exhibits a great saving of power.

The dinners given in the grill room by the Westinghouse and Bullock companies, and the hospitality shown to the delegates by the Richmond Conduit Company, Howarth & Sadler, Chapman Double Ball Bearing Company, and the Canadian General Electric Company, were of such excellent quality as to make the members yearn for the coming of another convention.

Several photos of the Convention were taken. Among the ladies in attendance were Mrs. J. E. Skidmore, Cobourg; Mrs. W. H. Breithaupt, Berlin; Mrs. Saxby, Bowmanville; Miss Belle Maunder, the Misses Haworth, Miss Howland, Toronto; Miss F. A. Reesor, Lindsay; Mrs. J. W. Purcell, Walkerville; Mrs. C. H. Mortimer, Toronto; Mrs. Bowlby, Berlin; Miss Boyd, Berlin; Miss Reagan, Cincinnati; Mrs. Evans, Quebec; Mrs. R. J. Parke, Toronto, and a number of others whose names we were unable to learn.

Mr. G. R. Duncan, M. Sc., superintendent and electrician of The Montreal Pipe Foundry, was married in Ottawa recently, to Miss Florence Benedict.

WE BUILD

Switchboards and Panel Boards

SEND US YOUR SPECIFICATIONS

We also manufacture a full line of Knife Switches, Time Switches and the Hill Automatic Switch

The Hill Electric Switch Co., Limited, 426 St. Paul Street
MONTREAL

SPARKS.

By a vote of 5 to 4 the council of Fredericton, N. B., have decided to install a municipal electric light plant.

The City Council of Winnipeg, Man., are considering a proposition for establishing a municipal telephone system.

The Bell Telephone Company have recently completed a long distance telephone line on the south shore of the Ottawa River.

The Bell Telephone Company are installing a metallic service in Parry Sound, Ont. The local manager there is Mr. R. Weller.

The Sarnia Gas & Electric Company, Sarnia, Ont., have been given permission to increase their capital from $75,000 to $225,000.

The bill of the town of Listowel, empowering the council to purchase the electric light plant has been passed by the Ontario Legislature.

Mr. Willliam O'Leary, electrical engineer, of Montreal, is installing in St. Joseph's University at Memramcook, N. B., a complete electric light plant.

His Majesty, King Edward, has given instructions to have electricity installed throughout his residence at Sandringham, to replace gas lighting, which has heretofore been in general use.

A company is being formed by Mr. S. V. Nicholls Halstead, manager of the Summit Lake Mining Company, to construct a telephone line between the Manitou Mines and Dinorwic, Dryden, Wabigoon and Goldrock, Ont.

The Wallingford Mica & Mining Company, composed of American capitalists, have established a mica factory in Ottawa in which fifty hands are employed. Mica mines in Templeton and Hull townships are being operated.

Financial arrangements have been made for a considerable extension of the lines of the Havana Electric Railway Company, in which Canadians are largely interested. Mr. Edwin S. Hanson, of Montreal is President of the Company.

A large double truck car of the Montreal Street Railway left the track on St. Antoine Street and crashed into a cigar store, breaking doors and windows and scattering the goods in the store. Although there were upwards of 50 people in the car no one was injured.

Mr. L. T. Barclay, of Whitby, Ont., has made application to the Dominion Parliament for the incorporation of the Algonquin Lumber & Power Company, to conduct a general lumbering and manufacturing business and to generate electricity.

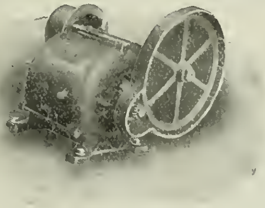
The West Isle Telephone Company, Limited, has been incorporated, to provide a telephone system on Deer Island, Charlotte County, N. B. The promoters include Messrs. Fred A. Richardson and W. A. Randall, of Deer Island.

As the result of an explosion in the east end station of the Montreal Light, Heat & Power Company, Napoleon Marian, fireman, was killed, and John Schwab, fireman, seriously injured. A report on the accident will be made by E. O. Champagne, boiler inspector.

The People's Rapid Transit Railway Company, of Toledo, Ohio, have awarded a contract to Morrison, Fowler & Scott for grading, covering the route between Napoleon and Defiance. The plan is to build north from Cincinnati and south from Toledo. The project contemplates a road 220 miles long. It is probable that the name of the company will be changed to the Toledo & Cincinnati Short Line Railway.

The Montreal Street Railway are studying the formation of a mutual benefit association among the employees, and are in communication with several companies having such an association in successful operation. The objects are to bring the men in closer touch with the management and to create a fund for relief of the sick and injured, to give assistance to widows and children and to provide pensions for those who have grown old in the service.

The annual meeting of the Canadian Telephone Company was held at Sawyerville, Que., recently, when very satisfactory reports were submitted. The company now have 482 telephones, distributed as follows: Sawyerville, 105; Cookshire, 181; Bishop's crossing, 46; Lake Megantic, 45; Bury, 42; St. Malo, 33; Angus, 29; Marbleton, 27; Paquette, 27; La Patre, 22; Scottstown, 13; Milan, 9. The miles of poles are 275 and of wire 546.



ARE YOU THINKING

of Trying to Increase
Your Earnings?

Probably the best way is to secure a good motor load. Our SINGLE PHASE SELF STARTING MOTORS give equal satisfaction installed on Single phase circuits or one phase of a Multiphase circuit. They require only one transformer to operate them. We will gladly tell you what they have done for others, and what they can do for you. Built in sizes ¼ to 35 h.p.

Wagner Electric M'f'g. Co., St. Louis, U.S.A.

CANADIAN OFFICES { Merchant's Bank Bldg., Montreal.
McKinnon Bldg., Toronto.

BROTHERHOOD OF ELECTRICAL WORKERS.

A largely attended conference of the Canadian members of the International Brotherhood of Electrical Workers, was held in Toronto on July 4th. Delegates were present from London, Ottawa, Winnipeg, Sault Ste. Marie, Hamilton, St. Catharines, Quebec, Montreal, Toronto and other places, representing over three thousand members.

Mr. H. J. Hurd, Grand Vice-President of the International Union, presided. The conference endorsed the passing of by-laws for towns and cities making it compulsory for all electrical workers to pass a competitive examination as to proficiency for the safety of the public. A warm discussion was held over the efforts that are now being made to nationalize all Canadian unions and sever their International relations, and a motion endorsing the actions of the International Brotherhood and pledging the hearty support of the Canadian conference for the future was passed unanimously.

SPARKS.

A by-law will be submitted to the ratepayers of Guelph, Ont., for the purpose of taking over the electric street railway.

Mr. E. Shipton, of the Vancouver Electrical Works, has submitted a proposition to install an electric plant for the corporation of the North Vancouver, B. C.

Correspondence from Fort William, Ont., states that F. H. Clergue has announced his intention of at once developing the water power of the Kakabeka Falls.

New tenders have been invited for supplying electric power for the City of Winnipeg, the companies tendering to submit their own specification.

Mr. William C. Campbell, President of the Detroit Trolley Wheel & Electrical Equipment Company, recently visited Toronto and other cities with the object of forming a Canadian company for the manufacture and sale of Potts' trolley wheel and other articles.

At the annual meeting of the Laurie Engine Company, Montreal, held last month, the old board of directors was re-elected, as follows: President, C. E. L. Porteous; Vice-President, William Yuile; John Laurie, F. L. Wanklyn, C. W. Davis, Walter H. Laurie and W. G. Ross.

The Nova Scotia Telephone Company held its annual meeting in Helifax last month. The total earnings for the year were $111,007.83 and the expenses $79,163.77, leaving a bolance of $31,844.06. A dividend of 6 per cent. for the year was declared. The number of instruments under rental is 2,969. Forty-five miles of pole, 146 miles of copper wire and 33 miles of iron wire have been added to the long distance.

Frank Van Tuyl & Company, electrical engineers, of Detroit, hove submitted to the council of Windsor, Ont., a report on the electric plant in that town. They recommend the installation of new generators, transformers, switch-boards and arc lamps, at an approximate cost of $8,580. They point out the the efficiency of the the old type of arc lighting machine is only 64, whereas that of the new type would be 93.

The annual meeting of the New Brunswick Telephone Company was held at Fredericton on June 9th. The usual dividend of 4 per cent. on the capital stock was declared. It was decided to string a copper metallic line from Fredericton to St. John and from Moncton to St. John. The officers chosen for the ensuing year are as follows: President, Hon. A. G. Blair; vice-president, J. L. Black; managing director, Senator Thompson; secretary and treasurer, W. E. Smith.

REMEMBER US

For Anything in the Line of

TELEPHONES

AND SUPPLIES.

The Sayer Electric Company

Phone Long Distance
Main 4546, East 17

10-12-14 Beaver Hall Hill, MONTREAL

INDEPENDENT UNITS

Direct Current Multipolar Generators

Direct-Connected to a throttle-governed Sleeper Engine.

For your FACTORY, your SAWMILL, your STORE, your YACHTS and your STEAMERS, your COUNTRY-HOUSE or your HOTEL.

The armatures will not heat.
The commutators will not spark.
The control is automatic, there is no fluctuation of light.
Taken altogether they are the most efficient and the most perfectly automatic units ever offered.
Compact and light—space and weight minimized.

Write us for particulars, catalogs and prices.

The SLEEPER ENGINE COMPANY, Limited

Office and works, corner Darling and Notre Dame Streets, Montreal

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIII. AUGUST, 1903 No. 8.

VANCOUVER TRANSMISSION PLANT.

BY WYATT H. ALLEN.

In the early summer of 1902 work was commenced on the hydro-electric transmission plant of the Vancouver Power Company, Limited, near Vancouver, B. C., and while the completion of the undertaking is yet a matter of a year or more, there are many items of interest connected with the construction in progress and the plans for the completed equipment.

The installation of the plant is for the purpose of furnishing light and power for operating the street and interurban railways in Vancouver, New Westminster and Burnaby, and will ultimately have a capacity of 24,000 h.p., for which the hydraulic end of the plant is being developed. The initial installation of machinery will have a capacity of 6,000 h. p.

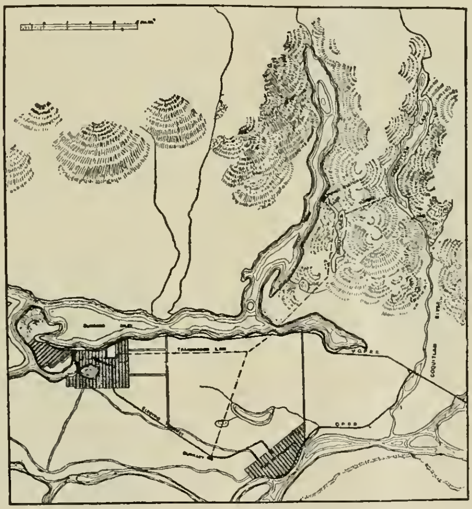


FIG. 1.—MAP OF PROPOSED DEVELOPMENT.

The sources of water supply for power are two very deep glacial lakes, known as Coquitlam and Trout, or Lake Beautiful. Their situation with respect to one another and to Vancouver is shown on the accompanying map. The first mentioned lake has an area of 2,300 acres, and is at an elevation of 32 ft. above the latter, which has an area of 460 acres. Both lakes are surrounded to their outlets by rugged mountains, rising abruptly from the shore lines, and between the two towers a granite range, 4,000 ft. above the water.

It is through this range that a tunnel, 13,000 ft., or nearly 2½ miles in length, is being driven to connect the two lakes for the purpose of using the stored waters of Coquitlam for the main supply and Trout Lake as a balancing reservoir.

Both lakes will be controlled by dams at their outlets and from the dam at Trout Lake steel pipe lines will convey the water under an effective head of 390 ft. to the power station, located just above high tide mark on the shore of the North Arm of Burrard Inlet, into which the water wheels will discharge.

The dam at the outlet of Coquitlam Lake will raise the water 12 ft. above low water level. It will be constructed of rock-filled timber crib, a type which has proven thoroughly successful in many mountain streams. The materials are provided by nature in ample quantity at the point where they will be used. The dam will be planked and constructed with an apron, extending far enough down stream to prevent any back cutting action by the water flowing over.

The tunnel is 9 ft. wide by 9 ft. in height, with rounded corners, and is being driven from both ends by compressed air drills. At the portals open cuts were carried into the solid rock, and at one end, where the depth of the open cut became inconvenient, a tunnel was driven for a short distance, temporarily timbered, and the ground above the roof of the tunnel stoped down through chutes in the roof directly into the car. Before the machine drills and air compressors arrived, hand drills were used, and the average progress was two feet per day in each heading, but since the advent of the drilling machinery this has been increased to 10 ft. per day. A system of electric haulage has been installed to facilitate the rapid and economical removal of the muck. The plant at each end includes a 100 h. p. boiler, 60 k. w., 500-volt generator and a four-drill, two-stage air compressor.

Ventilation is provided for by a 12-in. galvanized iron pipe, through which the air is exhausted by means of an air jet under 100 lbs. pressure, acting as an ejector. This is only put in operation for a few minutes after each blast to remove the smoke, the exhaust from the air drills furnishing all the fresh air necessary at other times. A concrete dam 350 ft. long on the crest and 50 ft. high is now in course of construction across the outlet from Trout Lake, and arrangements have been made for bringing ten 54-in. pipe lines from the dam, but only three lines will be completed at the present time. Each steel pipe line will be 1,600 ft. in length, 48 in. in diameter at the upper end, 44 in. in the middle section, and 42 in. at the power station. Close to the power station site on the shore of the North Arm, a wharf has been erected, at which steamers and barges from Vancouver may discharge their freight on to the cars of an incline tramway, built from the wharf to the tunnel portal at Trout Lake.

By this means all material for the camp at the tunnel portal and for the dam and pipe lines is delivered rapidly and with the least possible handling.

To deliver material to the tunnel camp at the Coquitlam portal is quite a different undertaking, since it can only be reached by wagon road from a station on the Canadian Pacific Railway, ten miles distant. For the greater part of the distance the road penetrates the dense forests, and in winter can be kept in a passable condition only by constant attention.

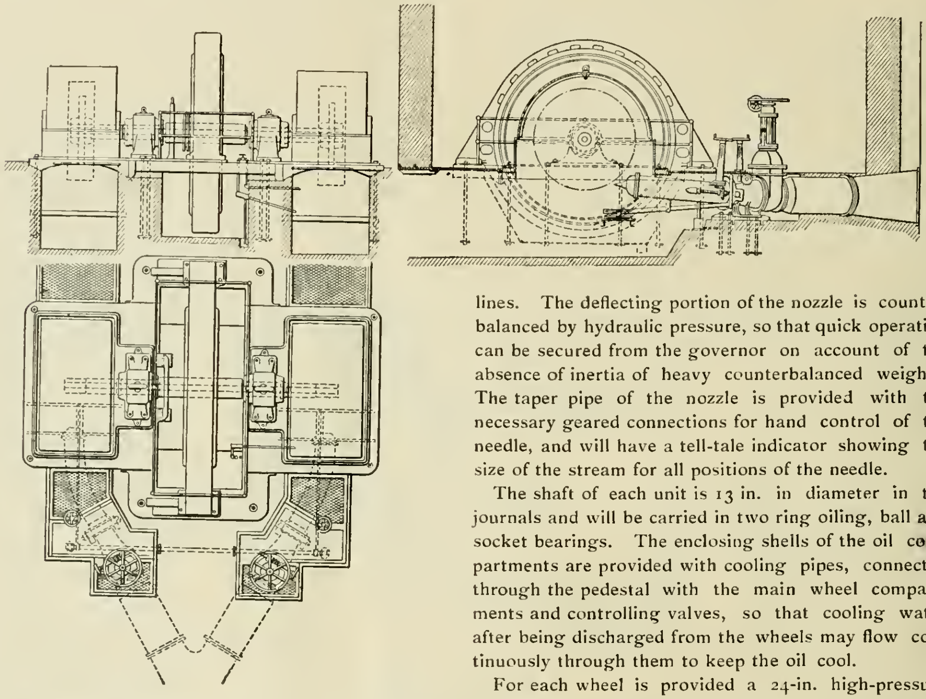


Fig. 2—Elevations and Plan of Water Wheels and Generators.

The power station will be constructed of granite masonry and much of the material excavated to obtain a building flat will be used in the walls.

The water wheel equipment will consist of three sets of impulse wheels, made by the Pelton Water Wheel Company, each set capable of developing a maximum of 3,000 h. p. at 200 r. p. m., under the effective head of 390 ft., and one set consisting of 200 h. p. wheels for driving the exciters at 580 r. p. m. Each of the main units will consist of two overhung wheels, one mounted on each end of the shaft of a 1,500 k. w. Westinghouse engine type rotating-field generator. The wheel centers are of the steel disc type, and fitted with cast-steel buckets, secured to the wheel rim by turned steel bolts driven in reamed holes. The hubs of the wheel centers are bored out for a press fit on a shaft 12 in. in diameter, and will be pressed on in place at the power station. Each wheel will be enclosed in a cast-iron housing, and provided with centrifugal discs and pockets, and suitable drain pipes for preventing leakage of water along the shaft.

Probably the most interesting feature of the equipment is the single combination, deflecting and needle regulating nozzle provided for each water wheel, and fitted with a high-pressure ball joint, which is leather-packed, and rocks on forged steel trunnion bolts. The joint permits of effecting regulation by deflecting the nozzle by governor or hand, independent of the control of the needle, thus permitting of load and speed variations, independent of any change of velocity in the pipe lines. The deflecting portion of the nozzle is counterbalanced by hydraulic pressure, so that quick operation can be secured from the governor on account of the absence of inertia of heavy counterbalanced weights. The taper pipe of the nozzle is provided with the necessary geared connections for hand control of the needle, and will have a tell-tale indicator showing the size of the stream for all positions of the needle.

The shaft of each unit is 13 in. in diameter in the journals and will be carried in two ring oiling, ball and socket bearings. The enclosing shells of the oil compartments are provided with cooling pipes, connected through the pedestal with the main wheel compartments and controlling valves, so that cooling water after being discharged from the wheels may flow continuously through them to keep the oil cool.

For each wheel is provided a 24-in. high-pressure gate valve, with roller bearing thrusts. The gates are all furnished with the usual hand wheel, and in addition there is provided a worm gear device, which can be connected at will to facilitate the working of the gate when nearly closed.

The governing of the water wheel units will be effected by means of three Lombard governors. The type adopted operates under water pressure, and the water used by them will be first passed through a filter tank, located some 200 ft. above the power house.

The two 80 k. w. exciters with their respective wheels will be mounted on a common bed plate, with a 120 h. p. induction motor between the two exciters. Each exciter will be provided with a pair of jaw clutch couplings and shifter rigging, so that either water wheel will drive its exciter and the induction motor at the same time. The motor leads are connected to the main bus-bars, and the motor is normally run at synchronous speed, neither giving nor taking electric power. Should the exciter water wheel nozzle become clogged and the speed fall, the motor immediately takes power from the bus-bars and drives the exciter until the nozzle is cleared by the attendant, or the other exciter unit started up. The deflecting nozzles of the exciters are arranged for hand regulation from the exterior of the wheel case through worm gearing.

The contract for the entire electrical equipment has been awarded to the Westinghouse Electric & Manufacturing Company, and includes the apparatus for the generating station and the sub-stations at Vancouver and Burnaby.

The three 1,500 k. w., 60-cycle, 2,200 volt alternators for the power station are of the rotating field type, and arranged for a movement of the external frame in a direction parallel to the shaft to allow access to the windings.

For the control of the apparatus at the power station the switchboard will contain nine panels, one for the induction motor and one for each exciter, three panels for control of the main units, and three for the control of the three sets of 550 k. w. air-cooled transformers, with their motor blower sets, consisting of 20 h. p motors and 110-in. Sturtevant fans.

The step-up transformers, static interrupters, high-potential switches and lightning arresters will be installed in a separate building located on the hill above and just back of the power house. As the static interrupters contain oil, they will be separated from the main room and each other by brick partitions.

The machinery for the sub-stations includes the usual transformers, rotary converters, switchboards, etc., for the reception and distribution of transmitted power.

The route of the transmission lines to Vancouver is 16 miles in length, and involves the crossing of a navigable arm of Burrard Inlet, with a span of 2,800 ft. On one side two steel towers 140 ft. in height will be erected to support twelve 9-16-in. galvanized plow steel cables with wire centers, but on the opposite side there is high ground and the cables will be supported on poles.

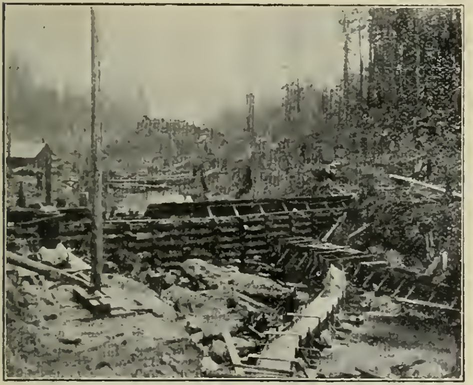


FIG. 3—TEMPORARY CRIB DAM.

Two independent transmission lines, each consisting of two 3-wire circuits of No. 2 copper, will be constructed on the same right of way, to a point near Barnet. From here one line will be continued to Vancouver and the other to Burnaby.

A transmission line already exists between Burnaby and Vancouver, which will be reconstructed to carry 20,000 volts, the pressure to be used on the new lines, and a new line will be built from Burnaby to New Westminster, thus providing what is in effect a double transmission line over the entire distance between the power station and each of the sub-stations.

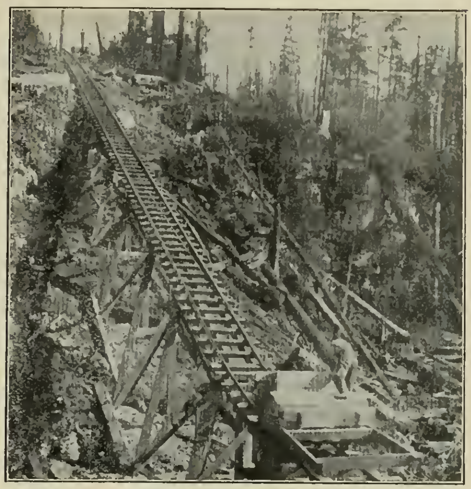


FIG. 4.—VIEW OF INCLINED TRAMWAY FROM WHARF.

Mr. Wynn Meredith, of the Engineering Offices, of San Francisco, is directing the entire work, assisted by Messrs. Hermon and Burwell, civil engineers, of Vancouver.—Electrical World and Engineer.

OIL AS A SCALE REMOVER.

One of the best, and most talked of and most abused methods of removing boiler scale, regardless of its thickness, is the introduction of coal oil. The proper quantity will depend upon how fast the scale comes off ; this varies in different localities. In some cases one pint in ten hours is about right, in others one-half pint and even one-fourth pint has been found sufficient. Very few boilers, no matter what size, require more than one pint in twenty-four hours, the oil to be fed into the feed pipe a drop at a time. This will be found sufficient for a boiler that will figure out 150 horse-power at twelve square feet per horsepower. Smaller boilers will usually require an amount in proportion to their size.

One mistake engineers frequently make when using kerosene oil is in using too much. Whether this is due to the recommendation of the parties selling the feeder, so as to prove their claims of efficiency by the rapid loosening of the scale, or to the desire for early results on the part of the engineer, is not for us to say, but it is a fact learned by experience that there are more men using too much oil than too little.

The Great Falls Power Company is the only one that has submitted a tender for the supply of electric energy for the city of Winnipeg, the price being $50 per annum per horse power.

The Sarnia Gas & Electric Light Company have arranged to obtain a supply of sawdust for fuel from the Cleveland-Sarnia Saw Mills Company. The sawdust will be conveyed from the mill to the boilers of the electric light company by automatic carriers.

ELECTRIC LIGHT AND WATERWORKS PLANT AT KAMLOOPS, B. C.

In the year 1894 the corporation of the City of Kamloops decided to install and operate their own waterworks and electric lighting plants. One year later the waterworks was completed and in the spring of the following year the electric light plant was put in operation.

The waterworks at that time consisted of two return tubular boilers, built by the William Hamilton Manufacturing Company, of Peterboro, Ont., and two duplex pumps, one being a Worthington with a capacity of 600 gallons per minute and the other a Northey underwriter's pump having a capacity of 900 gallons per minute against a head of 160 lbs. pressure per square inch.

The electric light plant consisted of one Robb-Armstrong, high speed, simple, automatic engine, cylinder diameter 13", stroke 12", running at 310 r.p.m., which was belted to a 60 k.w. United Electric Improvement Co. (Philadelphia, Pa.) alternator having a frequency of 125 cycles, 1000 volts, at 680 r.p.m.

The machinery was all installed in one building and continued to give satisfaction until 1900, when the rapidly increasing demand for both water and light rendered the extension of plant necessary. After receiving the advice of Mr. Willis Chipman, C. E., of Toronto, the City Council decided to abandon the old site and construct complete new works. This was done, and in the fall of 1902 the new works were taken over; the old pumps and electric plant being removed to the new building.

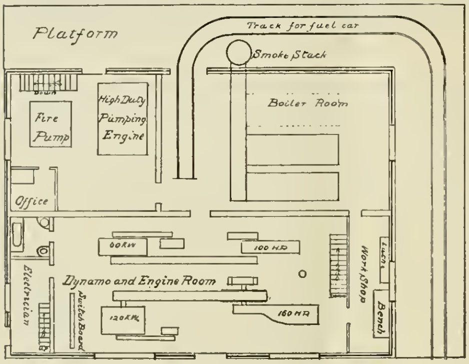


FIG. 1.—FLOOR PLAN OF MUNICIPAL POWER HOUSE, KAMLOOPS, B. C.

The power house (Fig. 2) is built of brick on granite and cement foundations, and has a frontage on Lorne Street of 80 feet, with a depth of 60 feet, the interior being divided on logtitudinal centre line by a brick fire wall extending the entire length, making on one side dynamo and engine room 60 ft. x 28 ft. 6 in., workshop 28 ft. 6 in. x 10 ft., office and lavatory, etc., 28 ft. 6 in. x 10 ft.; on the other side the space is again divided by a brick partition, making pump room 28 ft. 6 in. x 30 ft. and boiler room 28 ft. 6 in. x 47 ft.

The building is roofed with galvanized iron, with standing seams, laid on shiplap, the whole being carried by heavy timber trusses, by which the machinery can be hoisted for repairs, etc. The whole building is well designed and constructed, comfortable and convenient, and presents a very neat and attractive appearance.

The new electric light plant consists of a Robb-Armstrong, tandem compound, condensing, side crank engine, cylinders 12" and 20" in diameter by 16" stroke, running at 210 r.p.m., which is connected to a Northey jet condenser. It is giving splendid satisfaction, making an actual saving of 1300 lbs. of coal per 12 hours run over the high speed simple engine formerly used, and this when the engine is running under most disadvantageous conditions of light load, while the former engine was run under fairly good conditions, being for the greater part of the time well loaded. The saving will be more noticeable as the load is increased. This engine was manufactured and supplied by the Robb Engineering Company, of Amherst, N. S. It is belted to a Canadian General Electric standard 120 k.w. composite wound single phase alternator having a frequency of 125 cycles, 1000 volts, at a speed of 1070 r.p.m., and gives very close regulation.

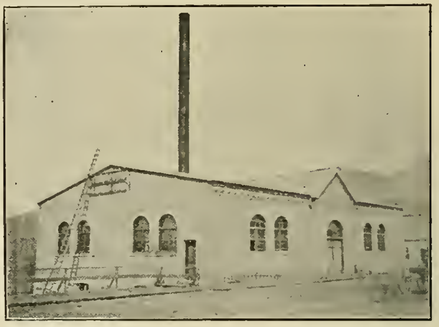


FIG. 2.—POWER HOUSE.

The switchboard (Fig. 4) is of blue Vermont marble, finely polished, and fitted with quick break switches, detachable fuse blocks, and Weston instruments in black oxide finish, the whole presenting a very handsome appearance. The lightning arresters, rheostats, transformers, etc., are mounted on the back of the board. The old board is temporarily set on one side. At the present time there are about 3,000 16 c. p. lamps wired on the circuits, not including the street lights, but as current is supplied to the consumers by meter, the average load does not reach the capacity of the plant.

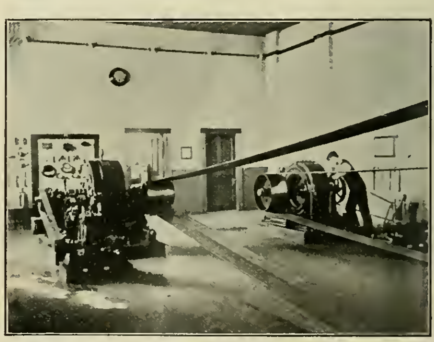


FIG. 3.—GENERATORS.

The streets are lighted with series incandescent lamps, mounted on neat goose neck brackets (supplied by Munderloh & Co., Montreal), placed at a height of 16 feet from the ground, and visitors say Kamloops streets are very well lighted. The lamps are placed 250 feet apart and are wired on two circuits of 26 in series, 6 amperes across the primaries. There is also another circuit of 14 32 c. p. lamps in series, and in the outlying districts several 16 c. p. lamps are temporarily connected to the commercial secondaries. The old plant is installed on the other side of the engine room and forms a duplicate or reserve.

This department is under the charge of City Electrician Fred J. Marshall, who has been in the employ of the city in that capacity for nearly eight years. T. A. Shackleton is second engineer.

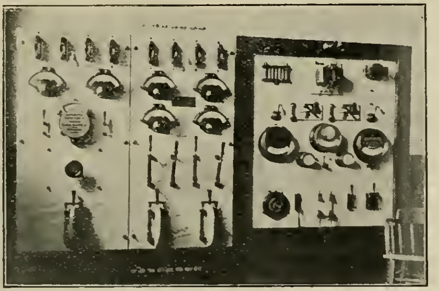


FIG. 4.—SWITCHBOARD IN POWER HOUSE.

The waterworks, which is under the control of C. L. Wain, who has been with the city for seven yaars, has also a reserve plant. The new high duty pumping engine (Fig. 5) was manufactured and supplied by the Smart Turner Machine Company, of Hamilton, Ont., and is a vertical cross-compound condensing Corliss pumping engine, the first of this type to be manufactured in Canada, and has a capacity of 1000 imperial gallons per minute against a head of 140 lbs. pressure per square inch. The pumps are placed immediately below the engine in the well, the concrete walls of which serve as foundations. The pumps are placed as near the water as practicable on account of the great difference between high and low water levels on the South Thompson river, from which the water is taken, about 600 feet distant from the power house.

The water flows into the well through a syphon 12″ in diameter, there being a rise in level between the river and the well of 2 feet ; after entering the well it has a drop of 18 feet to the bottom of well, giving at extreme low water a working head of nearly 6 feet ; this was done to avoid expensive ditching across the flat. This syphon was designed by Mr. Willis Chipman and is giving good satisfaction.

The pumping engine is run surface condensing, the discharge water from the pump being delivered through the condenser to the main, thus providing ample cooling medium without cost. This, of course, adds greatly to the efficiency. The condenser, air pump, hot well and boiler feed pump are placed in the basement in close proximity to the engine. The contract for this engine is not yet completed, as the manufacturers desire to make another test to reach the guaranteed duty of one hundred and fifteen million foot pounds, which was very nearly attained on the previous trial.

The water is delivered by the pump into the mains and thence to the reservoir, the mains being connected at the intersecting streets by special crosses, tees, and gate valves, thus giving complete control of the supply to any part of the town. The reservoir is on the hill immediately south of the town at an elevation of 280 feet, and gives a static pressure on the mains of 125 lbs. per square inch. It is excavated in the ground, the soil being a conglomeration of "hard pan" and gravel. The excavating was extremely difficult on account of the nature of the soil, digging being impossible, and the material could only be removed by blasting.

The sides of the reservoir are built of Portland cement concrete sloping to the top, 48 inches thick at the bottom and 24 inches at top. The floor or bottom of reservoir is dished and about 18 inches thick. This all received a coating of 1 inch of cement plaster, and was then repeatedly washed with cement wash to render it impervious. The capacity of the reservoir is 150,000 imperial gallons. It is covered with a strong shingled cottage roof and has a very attractive appearance.

The boilers were also manufactured by the Robb Engineering Company and are the "Mumford standard boiler", a tpye which possesses a great many important points in their favor, and which so far have have fully carried out the claims made for them by the manufacturers. They each have a guaranteed evaportation of 5,250 lbs. of water per hour from and at an initial temperature of 212° Fahrenheit, and have a working pressure of 125 lbs. per square inch. They are self contained, having no brick setting, being cased in a sheet steel case covered with 2 inches of asbestos plaster to prevent radiation.

The smoke stack was supplied with the boilers and is constructed of steel plates. It is 88 feet high and 45 inches in diameter, the first 40 feet being of ¼ inch plate and the remainder 3/16 plate. It is erected outside the building on a solid granite and cement foundation 12 feet high, making the total height from ground level to top of the stack 100 feet.

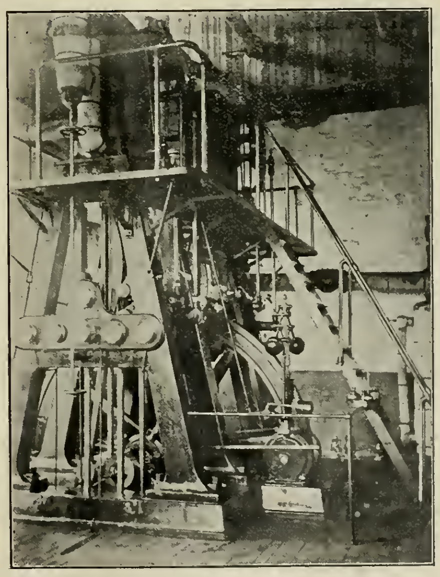


FIG. 5.—WATERWORKS PUMPING ENGINE.

The cost of the new building and plant, reservoir, mains, etc., was $50,000. The increased economy of operating the new plant compared with the old has resulted in a reduction of 5% on both water and light rates to the consumer.

THE LATE MR. F. H. BADGER.

The electrical fraternity learned of the death of Mr. F. H. Badger, superintendent of the Montreal Fire Alarm System, with deep regret. Deceased was taken ill some four months ago. It was thought a sojourn at Portland would lead to his complete recovery. For a time his health grew better, but the change was only temporary and finally death came on July 29th. He was one of the oldest employees in the civic service and was much respected for his sterling qualities.

The Late Mr. F. H. Badger.

Franklin Hodgkins Badger was born at Salem, U. S., 68 years ago. He attended the high school in Boston for some years, but was practically a self-made man. While young he entered the service of the fire alarm office at Boston, where he exhibited uncommon skill and intelligence. He remained there until 1862, and one year later was requested to organize a fire alarm system for the city of Montreal, of which he was appointed superintendent.

Mr. Badger was deeply interested in electrical matters and it was his good fortune to enjoy the acquaintance and friendship of many leaders in that science. He spent considerable time and money in research and invention, and, with the aid of Mr. J. Plewes, invented a device to prevent high tension foreign current from entering on interior wiring.

Mr. Badger from his youth was a student of the facts and philosophy of evolution. In other departments of science he was well versed and widely read. His conversational powers were remarkable; as a generous, whole-souled and upright man he made a host of friends. A widow and one daughter, Mrs. Alderman Turner, of Portland, Maine, survive.

PERSONAL.

Mr. Albert Dupuis, electrical engineer, Montreal, is at present on a business trip through England, France, Germany and Switzerland.

Mr. James Ross has resigned from the vice-presidency of the Toronto Street Railway Company. It is understood that he is desirous of giving closer attention to the affairs of the Dominion Coal Company and the Dominion Iron & Steel Company.

Mr. A. W. Douglas has tendered his resignation as secretary of the Shawinigan Water & Power Company, of Montreal, and is about to leave for the Pacific coast. He will be succeeded by Mr. Howard Murray, who has been connected with the company for a number of years.

INCANDESCENT, NERNST AND OSMIUM LIGHTS.

A series of tests of these lamps has been made in Berlin and reported in Elec. Auzeiger. It shows:

Osmium: Gradual increase in energy and decrease in c. p. Loss in c. p. 25%. A twenty-five-candle-power, thirty-seven-volt lamp, 1.65 average watts per candle; depreciation, $1.25 for 300 hours; average cost per candle-hour, 0.043 cent.

Incandescent: The average consumption is given as 3.2 watts per candle. The depreciation charge for 300 hours is taken at 8.4 cents. With electrical energy at sixteen cents per kilowatt-hour, the average cost per candle-hour is found to be 0.05 cent.

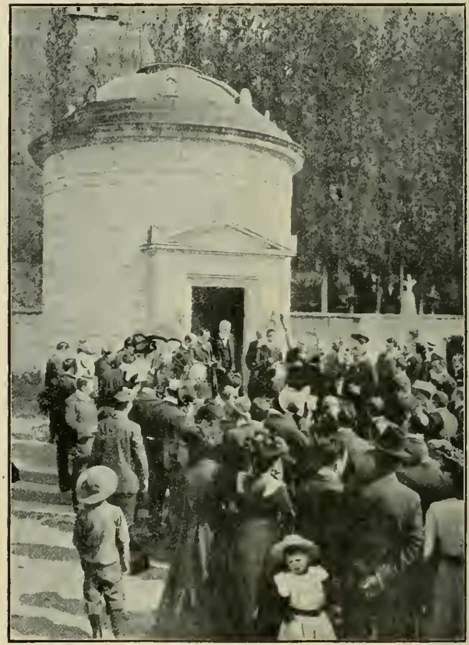
Nernst: A 130-candle-power, 220-volt Nernst lamp, 2.05 average watts per candle; depreciation charge for 300 hours, fifty cents, costing 0.035 cent per candle-hour.

HONORING A DEPARTED SCIENTIST.

The scene portrayed herewith, reproduced from Page's Magazine, represents the laying of a wreath on the tomb of Volta at Camnago, in the name of the British Institution of Electrical Engineers, on the occasion of an excursion to Italy, April 5th, 1903.

Professor Allessandro Volta (junior), who is the grandson of Volta, is seen standing between the President and Mr. John R. Hewett; the latter is presenting, on behalf of the students of the Institution of Electrical Engineers, a shield of bronze.

Allessandro Volta was born at Como, in 1745, and died there 1827. He was successively Professor of Physics at the Gymnasium in Como, and the University of Pavia, where he invented the electrophorus and the electroscope; he also devised several other electrical appliances, and in 1800 invented the Voltaic Pile, the far-reaching consequences of which were dealt with in Professor Thompson's speech, delivered at the tomb.



Laying a Wreath on the Tomb of Volta in the Name of the British Institution of Electrical Engineers

QUESTIONS AND ANSWERS

"R. T.": As the Thomson recording wattmeter has been explained to me, it is simply a little motor driving a registering dial. Now, if this is the case why does it run faster as the load gets greater, instead of slowing down as an ordinary motor does. Also will you give me the short formula for testing these meters by?

Ans. This instrument, as you say, consists of a motor driving a dial through a train of mechanism, the speed of the motor increasing with increasing load because, there being no iron in the armature or field, the former has practically no counter E.M.F., which means that the speed must be proportional to the strengths of the field and armature currents, that is, increasing with a rise in either the voltage of the circuit, which controls the armature current, or an increase in the current flowing in the circuit, which means a stronger field. The formula you refer to is as follows: $E\ C = 60\ G \times S$, in which E is the voltage, C the current, G the constant of the meter, and S the speed of the disc in revolutions per minute. The retarding magnets are moved in or out to increase or decrease the speed as required until the equation is satisfied. If you are working with alternating circuits E C must be muliplied by the power factor.

A Quebec reader asks: Is it necessary to separate the three conductors of a three phase line, when using lead cables in conduits? Does the lead cause any greater drop in the lines? What are the bells on the ends used for?

Ans.—There will be voltages generated in the three lead coverings which will cause currents to flow between them and which may injure the lead. They are usually separated by putting a braid or tape over the lead. The lead introduces some extra drop, which is ordinarily quite negligible. It can be entirely eliminated by using three conductor cables. The cable bells are for the purpose of taking care of the static discharge, which otherwise might puncture the insulation at the end of the cable. They also serve in the case of multiple conductors as a convenient means of separating the leads as they leave the cable proper.

"X Y Z": Please inform me through your paper of the proper formula for calculating h. p. on a 3-phase circuit when only one voltmeter and one ammeter are used, the load on all three legs presumably the same, being an induction motor with a few lights evenly distributed over all three legs.

Ans.: The horse power of a three-phase circuit, assuming equal loads in the three wires, and that the three voltages are also equal, is given by the formula

$$\text{H. P.} = \text{amperes (in one wire)} \times \text{volts} \times 1.732 \times \text{power factor} \div 746.$$

The power factor for a load consisting entirely of lights is about .95; if it is all motors .75 to .85, depending on the size, style, point to which they are loaded, etc. For a combination of the two, the motor being the larger part of the total, we would think that a constant varying from .85 to .9 was about correct, assuming a 30 h. p. machine or larger, if it is smaller than that .8 to .85 might give more correct results. It should be noted that the above formula, owing to the power factor being estimated, does not give absolutely correct results, which can only be obtained by the use of a power factor meter in conjunction with an ammeter and voltmeter, or else a wattmeter, which latter instrument combines the three others in one case.

"Station Manager": We have an induction motor, three phase, which takes 28 amperes at 400 volts. What power is it giving out?

Ans.—Before your question can be answered definitely you would have to know the power factor and efficiency of the machine in question; assuming 80% and 85% respectively the output in horse power would be

$$\frac{28 \times 400 \times 1.733 \times .8 \times .85}{746} = 17.69 \text{ h.p.}$$

"Engineer": Would you be kind enough to tell me what is a direct acting engine, also what is the meaning of the term trunk engine?

Ans.—A direct acting engine is one in which the piston and connecting rods act directly on the shaft or other device which they actuate. This is the form of the large majority of the engines used to-day, the indirect acting engines being those that do their work through the medium of an intermediate device such as the walking beam used in some types of marine and pumping engines. A trunk engine is one which has no piston rod, the connecting rod being coupled direct to the piston. It gets its name from the trunk or extension of the piston which it is necessary to provide to keep the latter in place. The oscillating piston engine, which has no connecting rod, is the opposite of this type.

"W. R.," Toronto: What is the difference between the auto-starter or compensator, used in place of a rheostat to start induction motors, and ordinary transformers? Why wouldn't transformers be satisfactory?

Ans.—The main difference is in the fact that there is but one winding on the auto-starter or compensator, which forms both the primary and the secondary, the current for the latter going through the same wire as the primary. This allows the apparatus to be much smaller, which means that it costs less than if an ordinary transformer with separate primary and secondary were used. Sometimes if lowering transformers are used with a motor, and their connections and winding permit of it, a voltage lower than normal can be obtained from them; a double throw switch is then sufficient in place of the compensator. Again in quarter phase circuits it is sometimes possible to obtain lower voltages by making various connections of the two phases, in which case also a double throw switch is all that is necessary.

"J. H.": How do you figure the horse power to run a street car? What is the difference between tractive effort and draw bar pull?

Ans.—The power required to operate cars on an ordinary level track, in fair condition, is figured from the following equation:

$$\text{Horse power} = \frac{\text{tractive effort in pounds} \times \text{speed in miles per hour.}}{375.}$$

The tractive effort is usually based on the requirements of a 10 ton car or train being 20 lbs. per ton, for a 20 ton car 15 lbs., and for a 30 ton car 10 lbs. per ton. It should be noted that each per cent. of grade will increase the tractive effort required by the same amount. The difference between tractive effort and draw bar pull is that the former is the term given to the total propelling power generated in any given vehicle; the latter is the net propelling power which the vehicle can exert on something else, after deducting the amount required to move itself.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY
THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.

1ST VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

2ND VICE-PRESIDENT:
A. A. WRIGHT, M. P., President Electric Light & Power Co. Renfrew, Ont.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.
A. A. WRIGHT, M. P., President Electric Light & Power Co., Renfrew Ont.
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A. B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.
C. K. GREEN, Superintendent Hamilton, Grimsby and Beamsville Electric Railway, Hamilton, Ont
CHARLES B. HUNT, Manager London Electric Co., London, Ont.
J. A. KAMMERER, Director Cataract Power Co., Hamilton.
H. O. FISK, Superintendent Peterborough Light & Power Co., Peterborough, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON,	Toronto
Vice-President, CHAS. MOSELEY,	Toronto.
Treasurer, A. M. WICKENS,	Toronto.
Registrar, J. G. BAIN,	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN,	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER	Baden, Ont.
Vice-President, H. E. TERRY,	Toronto, Ont.
Secretary, W. INGLIS,	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont
Conductor, J. STRUTHERS,	Sarnia, Ont.
Door Keeper N. BEAN,	Waterloo, Ont

New Canadian Industries.

Of late years there have been many encouraging signs given to this country that its future is bright and full of promise of good things to come, not the least among them being the establishing of local agencies or companies by United States firms which hitherto have filled their Canadian orders by exporting home made goods. The past month has seen public announcement made of the intention of two of the larger companies on the other side, the Bullock and the Westinghouse, to establish Canadian factories for the supplying of the business which has hitherto been taken care of by importations. It should be a source of satisfaction to all to see these two added to the many other industries which are just now being started on this side of the line and to feel that the large sums which hitherto have annually been sent away for the purchase of electrical apparatus will now be spent at home. Perhaps we shall some day have the further pleasure of seeing a large industrial company formed to manufacture apparatus of Canadian design. At present, curious as it may seem, but very few of the larger concerns operating in this country are building anything but United States designs; this being true not only in the electrical but also in the steam engine and water wheel industries. The Canadian headquarters and factory of the Westinghouse interests will be located at Hamilton, those of the Bullock Company in Montreal.

Electric Signs.

New methods for increasing station earnings are always eagerly sought for by operating managers, the latest being that of electrical signs, a field which shows promise of considerable development. These signs may take the simple form or rows or festoons of lights, plain or colored, hung round a building and following its outlines to a greater or less extent, or be put in the shape of reading matter, in which case the lamps are sometimes used purely as illuminators for ordinary signs, but more often they are arranged in the shape of the letters and form the actual words. This latter is again divided into the stationary and the flashing types, the latter offering endless opportunities to make an extremely varied and attractive display with but a comparatively small amount of apparatus. Perhaps the most effective form is that of the script type, in which the lamps are progressively lit with a rapidity which gives the effect of an invisible hand writing in the air. The actuating device or flasher of any of the changing signs usually consists of a revolving cylinder which makes appropriate contacts with the various fingers forming the terminals of the various lamps or combinations. The actuating force is usually a small machine of the fan motor type. The importance which this question of sign and decorative lighting is assuming is evidenced by the increasing number of sockets and receptacles coming into the market, which, primarily designed for mounting in exposed situations, are at the same time very easy to install. Another point which is being brought out by experience is that small lamps of low candle power, which obviously cost less to install, and particularly to operate, than the heretofore standard 16 c.p. lamp, give results which are quite equal to those produced by the larger unit.

"Train Control."

The tremendous strides being made by electric railway apparatus is nowhere so apparent as in the improvements which are constantly being made in the various systems of motor control. It seems to be generally conceded that for anything except what are to-day considered small cars, some method of master or train control is absolutely necessary, and consequently the various manufacturing companies are full of the problem of best meeting these demands. The recent absorption of the Sprague Company by the General Electric Company enabled the latter to add several features of the former company's system, which hitherto were not available to its method of handling this problem. Both these companies use purely electrical apparatus, the Sprague the usual form of drum controller, actuated by a motor controlled by the motorman, the General Electric people preferring to separate the various contacts each into its own simple element, actuated by a coil and plunger. On the other hand the Westinghouse Company, with their well-known predilection for compressed air, developed a system somewhat akin to that of the Sprague interests, but using compressed air as the motive power in place of the small motor. This company has now brought out a modification of their first method which embodies some new and interesting features. The main difference is that, following the practice of the General Electric Company, the grouping of the various fingers and drums into one main controller has been done away with, and individual contactors substituted therefor. These, instead of being opened or closed by the coil and plunger method, are actuated by compressed air, the valves of which are handled by small battery energized electro magnets. The air brake and car controlling systems are so interconnected that the application of the brakes automatically shuts off the current from the motors, if the driver has not already done so. Means are also provided whereby the current is shut off and the brakes applied if the motorman takes his hand from the controller, the same actions taking place if the train should break in two. There is also provided a device to give automatic acceleration, and thus prevent overloads, both on the power house as well as the motors. Further advantages claimed for the system are a great reduction in weight and the power required to operate it. Altogether it appears to possess many marked advantages over its predecessor and will be watched with interest by all those interested in heavy electric traction.

Variable Speed Induction Motors.

The question of variable speed motors is at the present moment a very live issue, and curiously enough in most of the discussions which arise, it appears to be taken for granted that direct current apparatus must be installed if anything but constant speeds are needed. It is, of course, admitted that where continual changes in speed are necessary, and where they extend over a very wide range, that the direct current motor has certain well recognized advantages. On the other hand, where the changes required are not very large, nor called for very frequently, the alternating motor can be made to give very satisfactory service. It is, of course, evident that, if it can do the work, the alternating type is in the great majority of cases the more desirable, as there is then no necessity for introducing motor generator sets or other apparatus for producing direct current. The standard induction motor is essentially a constant speed machine, the voltage and frequency remaining unchanged, but there are several methods by which it can be made to vary, such as altering the voltage applied to the motor, varying the resistance of the secondary, permutating or changing the number of the poles and again by varying the frequency of the current supplied. It is not usually practicable to vary the potential by changing its value as generated, and so some form of transformer compensator or reactance is required, which means additional apparatus and increased losses. Further than this, the losses in the motor are increased with the decrease in voltage, the tongue remaining constant, which means greater heating, or in other words a larger and more costly motor. On the other hand the varying of the secondary resistance means the transferring of these losses to an outside rheostat, thus a smaller machine can be used for a given output. Both of the foregoing methods lend themselves readily to large and continued variations in speed, the latter having the less effect on the voltage of the supply circuit. Permutation, or the variation in the connections of the primary winding so as to alter the number of poles, is obviously restricted in its application, it being scarcely practicable without great complications, to make the same winding suitable for more than two or three sets of poles. This means that the machine is limited to a corresponding number of speeds, and that the changes from one to the other are consequently somewhat abrupt. The efficiencies, however, at the lower speeds are considerably in excess of those obtained by either of the other foregoing methods, which makes the system a most desirable one if long runs are needed at say half or two thirds normal speed. Variable frequencies are generally obtained from two or more generators or a small motor generator set. This method, the voltage being varied with the frequency, gives excellent efficiencies and so is most desirable in that respect, though it introduces the additional cost and complication of the extra apparatus and wiring needed. Concatenation, or the connecting of the field of one machine to slip rings on the primary of the first, is occasionally found in alternating railway work. When so connected both machines run at half speed, the first because of the external resistance, as represented by the field of the second, which has been inserted into its armature circuit, and the second because the currents supplied to it, coming as they do from the secondary of the first machine running at half speed, or 50% slip, are of half the normal frequency.

The Acetylene Construction Company, of St. Catharines, Ont., have secured the contract for installing a street lighting system for Moosomin, N. W. T.

Mr. D. W. Marshall, of Sarnia, Ont., is wiring the new elevator at Point Edward. The contract calls for the installation of a 22 h. p. Robb Amrstrong engine, an 18 k. w. generator, and 150 incandescent and six arc lights.

Coming in contact with a feed wire of the Metropolitan Railway while working with some G. N. W. wires at Richmond Hill, Emile Nadore, a lineman, was thrown some distance in the air and fell to the ground, a distance of twenty-five feet. He sustained an ugly gash in the head and was terribly burrned, but his recovery is hoped for.

THE GROUNDED WIRE AS A PROTECTION AGAINST LIGHTNING.

The important question of the protective influence of grounded aerial wires over transmission lines was discussed by Mr. R. D. Mershon in a paper read at the recent convention of the American Institute of Electrical Engineers, of which the following is an abstract :

There are three ways in which lightning can effect a transmission line—by a direct stroke, by electromagnetic induction and by electrostatic induction. Protection against the first of these would be almost impossible, certainly impracticable. Fortunately, lines are not often struck by lighting. The second, electromagnetic induction, is, in the opinion of the writer, a theoretical possibility—nothing more. It is against the effects of the third, electrostatic induction, that lines are to be protected, whether by lightning arrestors or by grounded wires.

It appears, therefore, that if each wire of a transmission line 20,000 feet in length, the conductors of which consist of No. 00 wire, have stretched parallel to it and at a distance of 12 inches a grounded wire equal in size to the line wire, the potential of the line wire due to a charged cloud could not rise to exceed 30 per cent. of the value to which it would rise if the grounded wire were not present. As a matter of fact, if each of the line wires had its corresponding ground wire, the potential to which they could rise would be even less than this, because each line wire would be influenced not only by its own grounded wire, but by all the other grounded wires also. However, it is not usually the practice to employ a grounded wire so large as that assumed, and 12 inches is a smaller distance from grounded wire to line wire than would usually have place. The usual variation from these quantities will about compensate for the effect due to a greater number of grounded wires as usually arranged, so that the example taken serves its purpose as furnishing a criterion as to the magnitude of the effect of the grounded wires. It does not and is not intended to furnish a criterion as to construction or practical details.

Ground wires are usually of galvanized iron. This material is probably as good from an electrical standpoint as any other, since with the rapid flow which must take place at discharge the material of the wire itself will probably make little difference in the obstruction offered to the flow. The size of the wire will have an important bearing, since in general the larger the wire the less obstruction it will offer and also the greater its "sheilding action." Greater effectiveness will be obtained, of course, for given amount of material, from a number of grounded wires of smaller size than from a smaller number of larger size. Barbed wire is often used for grounded wires, but in the opinion of the writer it has no advantage over smooth wire.

Usually three grounded wires are installed, one on top of the pole and one on each end of a crossarm. They are generally tied to glass insulators, presumably for mechanical reasons, as all three wires are, of course, grounded. The wires should be grounded as often as possible, so that the obstruction to the flow between grounded wire and earth shall be kept as low as possible, thus keeping down the direct action of the grounded wire to as low a figure as possible.

The writer has known of a number of plants where grounded wires were installed. In one of these, as the result of a number of years of operation, those in charge of the plant feel sure that the grounded wires furnish a reliable and effective protection against lightning. In some of the other plants those operating think that the grounded wires furnish more or less protection, but are doubtful as to the amount. In still other plants those in charge feel sure that the grounded wires are of no value whatever, and constitute a nuisance and menace because of their liability to break and fall across the power wires. In some of the cases of doubtful success or failure the trouble may have been due to poor grounds or to the wires not having been grounded frequently enough, as in some of these cases the wires were not grounded at every pole. In all of the doubtful cases lightning arresters which were installed in addition to the grounded wires received more or less discharges during thunderstorms.

The following written contribution to the subject of high tension transmission was submitted by Mr. P. G. Gossler, of Montreal :

In reference to the subject of the grounded wire as a protection against lightning, it may be of interest to the members of the American Institute to know that this method of protection against lightning has been used on the transmission lines of the Montreal Light, Heat and Power Company for the last four years, with very satisfactory results. For three years the transmission lines were operated at two-phase, 12,000 volts, and for the last year at three-phase, 25,000 volts.

The two-phase transmission lines consisted of duplicate lines run from Chambly to Montreal, the total distance being about 17 miles for each line, of which 14½ miles was aerial and 2½ miles single conductor, rubber insulated, underground cables. The underground cable was divided up in three sections. The first section was about a mile and a half from power house, the second about 15 miles from the power house, and the third at the Montreal end.

In the spring of 1902 the two-phase transmission lines were changed to three-phase. The present transmission lines consist of duplicate lines running from Chambly to Montreal, the total distance being about 17 miles for each line, of which 15½ miles is aerial and 1½ miles underground cables. The underground cables are at the Montreal end and are three-conductor, paper-insulated cable. The present arrangement is two three-phase circuits on each pole line, the conductors being 30 inches apart and arranged in the form of an equilateral triangle. Three lines of barb wire are run on pony glass insulators on each pole line, two lines being run on the ends of the top cross-arms 32 inches from the line wire, and the third on a pin on the top of pole.

The barb wire is composed of two twisted No. 12 B. W. G. galvanized-iron wires with one four-point barb every five inches, and is connected at each pole by means of a soldered joint to the ground wire. This ground wire is stapled down the face of the pole and is twisted several times round the butt, after running through an iron pipe about eight feet long, which projects above the level of the ground, preventing the wire from being cut or broken, as well as affording an additional ground. The barb wire is tied to the glass insulators with a No. 12 B. W. G. galvanized-iron wire. The ground wire and pipe were stapled on the pole when the poles were being erected.

As the poles on the transmission lines are set 90 feet apart, the barb-wire lines are grounded about 58 times per mile, this frequent grounding being one of the most important points in the protection.

It has been the opinion of many electrical engineers that ordinary barb wire lacks good mechanical properties, is liable to corrosion and to cause interruption to to the service by breaking and becoming tangled with the transmission wires.

This has not been our experience. In the line described above ordinary commercial barb wire was used, and we have only experienced two cases of the barb wire breaking. In both cases it fell clear of transmission wires and did not become entangled with the conductors. We are of the opinion that our freedom from mechanical troubles has been due to the care exercised when stringing the line, and also by fastening to a glass insulator, instead of stapling to the cross-arms and top of poles. By an inspection of the line after it had been in operation over a year it was found that where the transmission line crossed over the railroad tracks there were signs of the barb wire deteriorating, due to the smoke from passing locomotives. The stretches were consequently removed.

We also use the Westinghouse low-equivalent alternating-current lightning arresters in conjunction with the barbed wire, banks of arresters being located at both ends of the aerial lines.

As is generally known, the climatic conditions in Eastern Canada are often very severe, and during the past four years we have experienced many severe wind and sleet storms in winter and many heavy thunder storms in summer, which storms have often more or less demoralized the local system in Montreal, while the transmission lines have not suffered.

We have undoubted proof of the usefulness of barb-wire protection as applied to our system. The first year and a half of operating our Chambly plant we did not have any protection against lightning but the barb wire. We might state that the first summer of operating we had the oportunity of watching the effect of a very severe storm which travelled from Montreal to Chambly, passing over the district through which our transmission lines run. This storm did considerable damage in Montreal as well as shattering several trees along the transmission line, and also damaged the local lines in Chambly, but no trouble was experienced on the transmission lines.

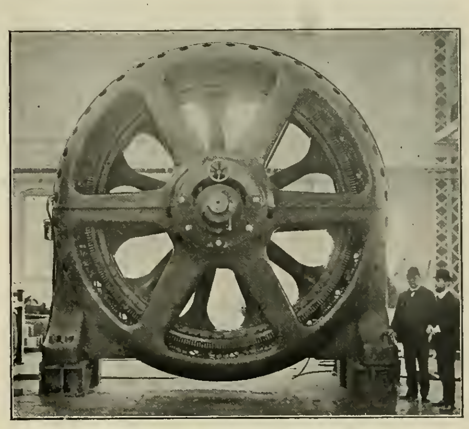
So satisfied are we of the usefulness of barb wire as a protection that we have installed it on many of local 2,400-volt circuits in and around Montreal with satisfactory results.

VALUE OF OIL RINGS IN BEARINGS.

It is probably not generally known that a shaft may be highly insulated electrically from the bearing by the film of oil which envelops the shaft, and that the oil film is capable of withstanding a comparatively high electric pressure. According to some measurements recently made by Dr. A. E. Kennelly and Mr. C. A. Adams, the short circuit of the bearings of a 125-volt 6-kilowatt Edison bipolar dynamo, having a normal speed of 1,800 revolutions per minute, ceased to exist above a speed of 100 revolutions. The electrical resistance was found to be 8.8 megohms in each of the bearings, which were 5 in. long and 1⅛ in. internal diameter. The insulation was found to break down periodically owing to accidental contacts between the brass oil rings and the sides of the bearing slots, but when the rings were lifted it was found that the insulation entirely disappeared, and was not restored until the rings were replaced and set in motion. This experience is a good demonstration of the importance of oil rings in maintaining an adequate flow of oil through a bearing.

BULLOCK INDUCTION MOTOR.

The induction motor illustrated herewith is doubtless entitled to be classed among the largest motors operating in Canada. It is of 450 h. p., and was supplied to the Montreal Water & Power Company by the Bullock Electric Manufacturing Company, of Cincinnati.



BULLOCK INDUCTION MOTOR.

LIGHT COSTS.

Prof. Vivian B. Lewes, the celebrated expert, estimates the cost of lighting by various methods, in a lecture recently delivered before the Petroleum Institute of London, England :

COST OF 1,000 CANDLES PER HOUR.

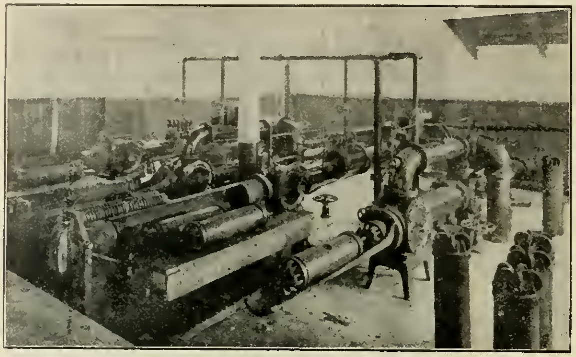
	Cents
Electricty 7 cents per unit :	
Incandescent	28
Arc	7.5
Coal Gas :	
Flat flame	36
Argand	24
Incandescent	4.5
Incandescent high-pressure	3.5
Oil :	
Lamp (oil at 16 cents)	14.5
Oil-gas (oil at 8 cents)	12.0
Incandescent lamp (oil at 16 cents)	4.5
Incandescent air-gas (spirit at 20 cents)	4.0

DOMINION EXHIBITION.

Although the dates set for the Dominion Exhibition at Toronto are Aug. 27 to Sept. 12, the formal opening will not take place until Saturday, Aug. 29, when, under the rules, everything will have to be in place and ready for inspection by the public from 9 a.m. to 10 p.m. All the special features, including Kiralfy's great spectacle "A Carnival in Venice," will be given that day. The Exhibition will be considered officially colosed at 10 p.m. on Saturday, the 12th of September, after which exhibitors must remove all their property from the grounds and buildings. No removals will under any circumstances be allowed before Monday morning, September 14th, except in the case of Live Stock, which may be removed after the parade of prize winners at 2 p. m. on Saturday, 12th September, and Agricultural and Horticultural products, which may be removed after 10 p.m. and 4 p.m. respectively on Saturday, 12th September, and Poultry at 4 p.m. Friday, September 11.

THE BOSTON PNEUMATIC TUBE SERVICE.

The problem of delivering packages is one that confronts every retail dealer in every line of goods. The wholesale merchant can confide his goods to the railroad or steamship company, knowing that at the other end his consignee will unload and take care of the shipment. But the distributor is facing a different problem. He must leave his goods at the homes of numerous customers, each and every one of whom expects his order to receive immediate attention. This becomes a serious matter in the large cities where the population covers a a vast area.


Terminal Station.—Boston Pneumatic Tube Service.

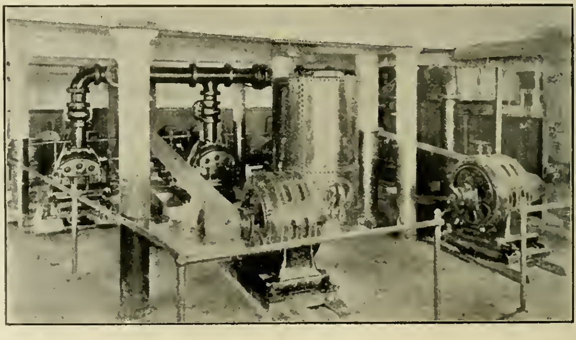
The American Pneumatic Service Company has instituted a novel method of distributing parcels by installing an underground pneumatic tube system in Boston. A central station has been erected in the very center of the retail shopping district at the head of Harrison avenue. From this station two pairs of tubes are laid, one pair running to the Back Bay sub-station on West Newton street near Huntington avenue. The other pair runs to the south end sub-station on Washington street. From the south end the line is continued to the Dudley street station in Roxbury, near the terminal of the elevated road, and from Roxbury it runs to the Dorchester sub-station at Upham's Corner. The parcels are collected from the stores by teams and brought to the central station. There they are sorted and sent by tubes to the sub-stations above named, and delivered from them by team or messenger. The average time of transit from the central to the Dorchester station is about ten minutes as against forty minutes by team.

The tube is operated by compressed air, which forces a carrier along in a manner similar to that in use in the familiar store service cash system. The air required is about 1,400 cubic feet per minute at an average pressure of 1.9 lbs. With the lines filled with carriers this pressure may rise to as much as 2.1 lbs., and in the shorter lines, with no load, it falls off to 1¾ lbs.

Before entering the compressors the air passes through a tank filled with calcium chloride, which effectually removes all moisture. This tank is open to the atmosphere, and the pipe connections are so arranged that the air of the incoming line passes through the tank and returns to the compressor. Only such air has to be dried as is lost through leakage or used for operating the machines.

The compressors are duplex belt-driven with 24 in. x 12 in. cylinders. There are two each at the main, south end, and Roxbury stations, and one each at Dorchester and Back Bay. The compressors are driven by 50 H. P., three-phase induction motors of the internal resistance type. The idea of belted compressors and electric motors was adopted after a long investigation into the relative merits of steam, gas and electric power. Steam was early abandoned because of the necessity of having a licensed engineer at each plant, and on account of the room required for boilers, coal bunkers, etc., gas engines appeared attractive on the score of economy, but it was decided that a power was needed that could be more easily controlled ; that is, one where the starting or stopping of the compressor would be an easier matter. Turning naturally to electricity, the decision lay between direct and alrernating current. The induction current motor with no commutator to burn out, with no danger of burning out the armature, and its high efficiency at half load, was finally adopted. The motors have been running for a year, without giving the least trouble, and with a total bill of repairs of less than five dollars, all of which was for paint.

The carrier used is a complete departure from all previous designs. Instead of using felt or some other substance for bearing rings on which the carrier can slide, five wheels are placed on each end of the carrier. The heads which carry the wheels are slightly flanged and it is found that the air that leaks by is not sufficient to be noticeable. The cover is hinged on the side, opening the whole length of the carrier, and nearly one-half its circumference. It is locked by a trident at each end which slips into holes drilled in the head. Such a heavy carrier cannot be allowed to come out of the open end of the tube the way that small carriers do in the store service systems. The receiving terminal is an air cushion closed at one end by a revolving valve which is opened and closed by a cylinder and piston operated by compressed air from the tube. Normally this valve is closed. When the carrier enters the receiver it compresses the air in front of it. This pressure affects a small auxiliary valve. When the


Electrical Driven Air Compressors—Boston Pneumatic Tube Service.

carrier is brought nearly to rest the auxiliary overbalances and moves the controlling valve of the main cylinder. This opens the revolving valve and allows the carrier to roll out. Just at the end of the receiver two vanes are mounted so that the pressure of the air behind the carrier tends to move them. This motion is made use of to restore the auxiliary valve to normal position and close the receiver. As the current of air is kept flowing all of the time, it is necessary to have some method of introducing the carrier into the tube. This is done by a simple adaptation of the air lock. The valves are moved in the proper sequence by one cylinder controlled as in the receiver.

The pipe used is cast-iron water pipe, machined at the joints to make a close fit. It was laid in the same manner as water pipe, with lead and yarn joints. The curves are of cast-iron, 12 feet radius to center line, the circular section of the straight pipe becoming elliptical at the bend. The bends were cast in sections, the standard 90-degree bend consisting of three 30-degree sections bolted together. In laying, the usual obstacles of manholes, sewers, water and gas pipes and electrical conduits were encountered. To add variety to the work, the foundations of the elevated road and the roof of the subway had to be avoided. On Harrison avenue a long stretch of soft mud was encountered which made it necessary to excavate below grade and put in a bed of good bank gravel. This, when well rammed, made an excellent foundation. Work was commenced September 4, 1900, and the first carrier was sent through on March 10, 1901. Business was commenced June 1, 1901, and has been carried on steadily ever since.—E. D. SABINE, in Railroad Gazette.

NEW EQUIPMENT FOR THE CATARACT POWER COMPANY.

The Hamilton Electric Light & Cataract Power Company's steam power station in Hamilton, which will be used as an auxiliary to its water-power plant at DeCew Falls, 34 miles distant, is to be equipped with the following machinery recently ordered from the Westinghouse Electric & Manufacturing Company: Two 1,000-kilowatt, two-phase, 2,400 volt, 8,000 alternation, engine-type generators, each driven by a vertical Corliss engine furnished by the Goldie & McCulloch Company, of Galt, Ont; one 50-kilowatt motor-generator exciter set for these alternating-current generators, consisting of one 75-horse-power, two-phase, 400 volt, type C induction motor and a 50 kilowatt, 125 volt, compound-wound, engine-type generator, constituting a two-bearing set; also a switchboard consisting of two generator panels.

In the receiving station of the Hamilton Light & Power Company, which adjoins the auxiliary steam power station in Hamilton, will be installed six 500-kilowatt, oil-insulated, self-cooling Westinghouse transformers with transformer panels, stepping down the current from 20,000 volts or 40,000 volts three-phase to 2,400 volts two-phase.

The two engine-type alternators mentioned above will be operated in parallel with the secondaries from these transformers.

For the water-power station at DeCew Falls, the Westinghouse Company will furnish two 5,000-kilowatt, three-phase, 2,400 volt alternators, which will be direct coupled to water wheels that are being built in Italy; two 100-kilowatt motor-generator exciter sets, each consisting of a 150-horse-power, 2,400 volt, type C induction motor, and two 100-kilowatt, 70 volt, direct-current, compound-wound, engine-type generators, constituting three-bearing sets; five 2,500 kilowatt, oil-insulated, water-cooled transformers, transforming from 2,400 volts three phase to 22,500 or 45,000 volts three phase; together with the necessary switchboards to control the apparatus recently ordered as well as that already installed in the station, aggregating eight separate switchboards with a total of 18 panels, these to be equipped with type F instruments and type C and B oil switches throughout.

POWER CABLE CONDUITS AT NIAGARA.

The Niagara Falls Power Company is making a very important change in the method of running its cables between power house No. 1 and the transformer house. It will be remembered that power house No. 1 and the transformer station are on opposite sides of the inlet canal, the two being connected by a stone bridge over the canal. This bridge was erected for carrying the cables over the canal, and the practice has been to string them through the interior of the structure, but now a new conduit has been built immediately under the bridge.

On January 29 last, it will be remembered, lightning started a fire in the basement of the transformer station, and the flames were carried over the bridge, destroying the cable installation and temporarily putting power house No. 1 out of business. Following this fire, the company built a cable conduit, 805 ft. long and having 24 ducts, from the south end of power house No. 1 around the west side of the Forbes subway, and through 20 of the ducts cables of 1,000,000 circular mils were laid. This relieved the bridge over the canal of some of its cables, and now, says the Eletrical World, the new conduit will entirely do away with the service of the bridge, which is being torn down.

This new cable conduit has 60 ducts, the openings in which are 3¼ inches. The ducts are laid in groups of twelve, and a feature of their construction is that no concrete is placed around them except sufficient to hold them in place. This style of construction was adopted in order that the ventilation might be as free as possible, the difficulty being to get rid of the heat where such an amount of power is carried as passes through this conduit, for all of the load that is transformed, as well as some that is delivered direct, passes over the cables in the conduit. To facilitate ventilation further ventilators have been placed in a walk that is laid over and a little above the conduit. With this change, all of the current from power house No. 1 and also that from power house No. 2 passes through underground conduits, giving much greater security and removing the danger of a repetition of such a disaster as that of last January.

Mr. T. Chouinard, 5 Lee street, Quebec, has invented an electric switch comprising an insulating base, a pair of lateral contacts, a central contact having a tube fixed thereto, a switch-key having a shank rotably mounted in said tube and inclosed thereby for a greater part of its length, a feather mounted on one end of said shank and projecting between said lateral contacts and adapted to contact with either alternately, and a lever-handle attached to the other end of said shank.

MONTREAL

Branch office of the Canadian Electrical News,
Imperial Building.

Montreal, August 6th, 1903.

The Hackman's Union are making determined efforts to prevent the running of tourist trolley cars ticketed "Seeing Montreal"; in fact, they applied for an injunction, claiming the action to be contrary to the charter granted the Montreal Railway Company. Happily, the application for an injunction was dismissed, as it should be; for surely the city of Montreal is not to be made suffer for any such Union. It has suffered sufficiently from Unionism in its various forms for one year at any rate. The cars continue to run and fill a long-felt want, as they cover a large section of the city and suburbs. The remarks of the man on the street, however, are very much to the point, viz., why do not the Montreal Street Railway run these cars themselves instead of sub-letting such tourist traffic to a Yankee syndicate.

Local construction work is very dull, little or no wiring being under way, and the wiremen seeking work are pretty much in evidence, although really good, steady men are generally kept on by their respective employers slack times or no.

Quiet a few representatives from United States firms have paid the Montreal trade a visit since convention time, among which might be mentioned: American Circular Loom Co. (Mr. H. B. Kirkland) Chelsea; American Brass & Copper Co., New York; W. R. Ostrander & Co. (H. D. Monk) New York; Gibson Gas Fixture Co., Philadelphia; Electric Gas Lighting Co. (Mr. Howes) Boston.

The employees of the Montreal Light, Heat & Power Company held their annual picnic on Saturday, August 1st. Sports, games, and dancing were indulged in, and contests were judged by several of the company's officials. The attendance was large and the picnic voted a success.

The fan motor business this season has been a distinct failure owing to cold and inclement weather.

The architects of Montreal almost without exception, when writing specifications for the electric light wiring in residences, etc., are in the habit of stating that the work is to be done in accordance with the rules adopted by the Canadian Board of Fire Underwriters, and with "approved" materials, also that a certificate of inspection to that effect is to be furnished. The next move is to proceed to repeat the Underwriters' rules, stating that rubber covered wire, porcelain insulators, etc., shall be used and other superfluous advice already fully covered by their preamble. All that is necessary to let the contractor know in addition to the preamble already quoted, is the number of outlets, capacity of lights to be carried on each, the location of such outlets, and switch outlets. The architect might also remember that the day is gone past when electric light wires can be pushed into a chink in the brick work or any other hole or corner. A certain quantity of right of way is necessary for a good job.

NIAGARA AND ITS POWER.

The Commissioners of the Queen Victoria Park, Niagara Falls, have issued their seventeenth annual report, in which, concerning the power development at the Horse Shoe Falls, they say: "The production of electrical power as a means of providing revenue has perhaps more than anything else been characterized as vandalistic in its ultimate effect upon scenic conditions in the park. It should be borne in mind that at the time the park was established the science of producing electrical energy for motive purposes was practically in its infancy, the first electrical street railway in America having been put in operation in 1887. It was only when the practicability of transmitting electrical power assumed shape that the matter was considered by the commissioners as a possible means of revenue. The commissioners do not claim that they acquired the portion of the park lying south of Cedar Island looking to the utilization of this portion of the property as being eminently suited for the purpose. They do claim, however, that their recommendation to the Government which brought about the acquirement of this additional property has resulted in the greatest pecuniary advantage. Had the property not been expropriated when the park was founded—viewing it now in the light of what has transpired on both sides of the river—that part of the property would doubtless have been acquired by capitalists and laid out as a manufacturing district without reference to its scenic environments, as has been done on the American side of the river north of the steel arch bridge, to the irreparable disfigurement of the river bank. On the other hand, had it been expropriated after its capabilities as a center for production of electrical power on a large scale were demonstrated, it is quite probable that the price of such expropriation instead of the original cost of $100,000 would have been many millions of dollars, determinable only by the capitalization of the revenue obtainable from possible electrical franchises.

"Coming now to the charge that the commissioners have, in granting certain power privileges, committed acts of vandalism that will ultimately ruin the scenery of Niagara Falls, the commissioners have to state that with the exception of the Ontario Power Company's power house in the gorge under the falls, hereafter referred to, all the proposed works connected with the generation of electricity are practically beyond the territory originally designed for park purposes. When the electrical power works are completed not a single view of the falls, rapids or gorge under the falls will be obstructed in the slightest degree. On the contrary, the filling in of the shore line above the falls by excavated material from the tunnels will increase the park area very considerably and will permit of roads and walks being constructed on the margin of the river which will greatly improve the views of the upper rapids, and at the same time cover the foreshore, which in some places has become exposed by the recession of the waters, owing to the breaking away of the cataract. The waters forming the Dufferin Islands will be completely restored and improved by the construction of cascades and miniature falls, and, besides, the area at that congested point in the park will be considerably enlarged.

"Respecting the construction of the Ontario Power Company's power house in the gorge under the falls the commissioners of the State reservation made representations to the board in July last and were granted a hearing with particular reference to the erection of the structure at the location, the contention of the commissioners of the State reservation being that the building would not only disfigure the landscape as viewed from several points in the American reservation, but would also be objectionable from an æsthetic standpoint and at variance with the natural conditions desired by the commissioners on both sides of the rivers.

"On the other hand, it was shown by the Canadian commissioners that the location of the building in question would present no obstruction to the free views of the falls or river from any point on the American side, and as the building would be far below the surface level of the park a part of the roof and two gable ends would be the only parts of the structure seen from any point of view within Queen Victoria Park. It was further pointed out that to make the building in any sense a conspicuous or objectionable feature of the landscape would depend solely upon the design and character given to it.

"The commissioners have also arranged for the early removal of the large and unsightly building which is so conspicuous from the American side, and which was originally constructed for a museum, but which has recently been used for a restaurant and shelter building. The removal of this structure, which has formed quite a striking feature of the park, and the substituting of a modern refectory near the center of the picnic grounds, will remove from the park one of its most objectionable features, and will more than counter-balance any temporary disfigurement which the construction of the power house may cause.

"All of the works and structures connected with the electrical power projects have been designed with the object not only of doing the least possible injury to scenic conditions, but the commissioners are confident in the belief that when the several works are completed the consensus of opinion by the vastly increased numbers of visitors who are expected to visit the park will abundantly sustain them in their contention that the park, as a whole, with its wealth of electrical machinery, will then be of tenfold greater interest to the great majority visiting it. In addition, not only will the immediate locality beyond the park be built up into one of the great manufacturing centers of the world, but the quickening impulse and vivifying effects of the whole of the world's latest and most perfect form of energy—created and sent forth by the Falls of Niagara—will be felt from end to end of the province."

TELEGRAPH and TELEPHONE

CONGRESS OF WIRELESS TELEGRAPHY.

The First International Congress of Wireless Telegraphy convened by the Imperial Post Office, opened in Berlin, Germany, on August 4th last. Forty-four delegates attended, representing Germany, Russia, France, Italy, Austro-Hungary, Spain, and the United States.

The Congress was called upon Germany's invitation with the avowed purpose of agreeing on international regulations to control the operation of wireless telegraphy systems, and prevent any one system getting a monopoly. The proceedings are secret.

TELEPHONE COMPETITION.

Some of the western Ontario papers are still keeping up their demand for a competitive telephone service. They may have some excuse for the agitation, but it is most difficult to see it at this distance. If there is any one public utility in which it is desirable that a monopoly should exist it is in that of telephones. Experience has taught those localities which have had a competitive system that far from being a source of benefit to the community, the competition has actually resulted in what is far worse than loss—waste. The merchant has not found any profit in being compelled to install two services when one would have answered equally well. As a matter of fact the proportion of duplication has been as high in many cases as 50 per cent., that is half the telephone users were paying nearly twice as much as necessary in order that the other half might have the benefit of competition. Experience has also shown that this competition has been comparatively short lived. It has usually been founded upon cheapness, and if there is anything on earth in which cheapness is detrimental to satisfactory service telephone communication is that thing. The result has usually been that the weakest organization has finally been compelled to retire from the fight with a heavy loss to those who put their money in the venture, and a more or less serious disturbance of the telephone service of the community. In many instances these investors have been led into the loss of their money by the fairy tales of promoters. It is generally easy enough to provide figures which will show a certainty of returns, but it is quite another matter to provide dividend cheques which will be honored at the bank. There is no one who realizes this more clearly than the promoter, and this may be one of the reasons why his cash contribution is usually small, if not entirely lacking.

The public demand is best served by one company. There should, however, in the case of a constituted monopoly such as this, be some provision for the protection of subscribers from extortion, and in this respect Canada occupies a somewhat peculiar position, the control of the rates being vested in the Governor-General-in-council, who may in case of complaint by any municipality fix the rates or appoint a judge of one of the Superior Courts to hold an enquiry, compel the attendance of witnesses, examine them under oath and require the production of books and papers. Under the provisions of these regulations the company is compelled to show that the rates it proposes or which it objects to are either absolutely essential for the purpose of providing a fair return upon the capital investment, or that they are so low that it will be impossible to secure such a return. Not only are local rates covered by this act, but also long distance rates, so that if the company takes advantage of any municipality it is its own fault, at least until it has been demonstrated that the relief provided is inadequate. It is somewhat strange that despite the fact that this law has been upon the statute books for more than a year, not a solitary attempt has been made to set its machinery in motion, though there have been more or less frequent complaints, more or less loud, in the usual vein, of extortion, etc. If the people of any municipality are being robbed it is their own fault. That there is still talk of attempts being made to secure a reduction of rates by the organization of new companies, while the method provided by law remains untested, may be considered conclusive evidence that the basis of the proposed opposition rests upon the hopes of self-aggrandizement of the promoters at the expense of those whom they may be able to lead into their venture, rather than upon any desire to benefit the public at large. It is just as well that the man with money looking for an investment should bear this fact in mind.—Montreal Gazette.

MUNICIPAL SERVICES AT FORT WILLIAM.

The municipal telephone plant at Fort William does not appear to have been the success that has been claimed for it, judging from the following statement in the "Times-Journal" of that town of 23rd July, over the signature of Mr. A. F. Woodhead, a prominent citizen :

"The public (electric light and telephone) services have been administered with inefficiency and inaptitude, culminating in the destruction of the town hall, with its valuable records, a costly law-suit in which the town has been signally worsted, and to-day we have another breakdown in the electric light plant, simply through sheer mismanagement, which will cost a large sum and deprive the citizens of light for probably some weeks. The municipal telephone service is so bad that every user of it is disgusted and supporters of legitimate public ownership are chagrined and disappointed."

SHORT-CIRCUITS.

The DeForest Wireless Telegraphy Company is removing its instruments from the station on Point Hill, Hamilton. The experiments were successful, but commercially it has not been profitable.

A new agreement with the Bell Telephone Company and the city of Hamilton is being drawn up. The prices for 'phones will remain the same, but all will be fitted out with the long-distance equipment. The agreement will last for five years, and the company will pay $2900 a year and a bonus of $1,450.

Mr. James Kent, general manager of C. P. R. Telegraphs, accompanied by Mr. D. S. Jenkins, the western superintendent of the company, has just completed an inspection of the lines between Winnipeg and the Pacific coast. New copper wires are being strung from Winnipeg to Brandon, Napinka and Minnedosa, and from Calgary to Macleod.

Mr. Frank G. Walsh, general superintendent of the Bell Telephone Company's western lines, has announced the appointment of Mr. John R. Richardson to the position of manager of the Winnipeg office. Mr. Richardson has been with the Bell Company almost continuously since the opening of the Winnipeg branch and is very popular with the public.

CHIMNEYS.

By W. H. Wakeman.

The following rules concerning the construction of chimneys are very suggestive, and it appears as if they might be safely followed in practice :

The foundation of a chimney may be composed of concrete, brick or stone, according to which is the most convenient. Concrete is preferred, as it secures a better bearing than large stones, because they only rest on the soil in spots until a great weight is put upon them, when there is a chance for them to settle unevenly. On the other hand, concrete rests evenly upon the soil when first laid, and, as it hardens, it becomes one solid mass, forming a superior foundation.

Concrete should be laid about one month before the chimney is to be built upon it, in order to give it a chance to firmly set before it is required to support the great weight that is to follow. If it rests upon clay or loam, it should be large enough to reduce the weight resting upon it to two tons per square foot, but if there is a thick bed of gravel to build on the load may be increased to four tons per square foot. If the soil is spongy it must be excavated down to something more solid, but if this is not practical, piles must be driven down until they reach soil that supports them firmly.

The external diameter at the base should not be less than one-tenth of the height, and the outside batter may be from one-sixteenth to one-quarter inch per foot, according to the judgment of the designing engineer. The location of it will assist about deciding this point, for if it is to be exposed to fierce gales it will need to be broader at the base, hence will naturally have the greater batter, but if it is surrounded by high buildings the batter may be less, for obvious reasons.

For chimneys from two and a half to say five feet in diameter the upper part for eight or ten feet need be only one brick, or eight inches thick. For those exceeding five feet, a wall twelve inches thick is right. The whole should be so planned that the walls shall decrease in thickness (as the superstructure increases in height) at the rate of four inches for each twenty or twenty-five feet.

The cap should either be made in one piece, or, if composed of several, they ought to be firmly bound together, but wrought iron bands should never be used for this purpose, as they rapidly oxidize and are unsatisfactory on this account. It is obvious that a cap should be as heavy as possible, yet small, so as to avoid presenting too much surface for gales of wind to act on.

The flue may be built of uniform diameter its full length, or it may be slightly contracted at the top without reducing the intensity of the draft. Sone engineers prefer to have a flue larger at the top, but this does not improve the draft, yet it renders the construction more difficult, hence more expensive, without giving adequate returns.

This was proved in at least one case. It was an iron stack that was larger at the top as originally constructed, but during the course of other changes at that plant this was reversed and put on the same foundation, to be used under like conditions as formerly, but the draft was not affected by the change.

We are sometimes told that chimneys should never be built into buildings, and this is a good rule to go by. Still there are exceptions to it, for sometimes a chimney forms part of a building without objectionable results.

One objection presented to this plan is that when a chimney is built independently of other structures it is swayed by the wind. If a high chimney is to be built near a one-story boiler house it had better stand alone, but where the building is nearly as high as the chimney, which is frequently the case, it must be held by the building, hence this objection is dispensed with.

The expansion of a chimney is greater than the walls of the building, when heavy fires are carried under the boilers, and while this is an objection, it is at least partially overcome by building the core independent of the outer walls, with a good air space between them. While this is expensive, it is necessary in order to provide for expansion of heat, whether the chimney stands alone or forms a part of some building.

This air space should be covered at the top to prevent ashes and cinders from collecting in it, but at the same time care must be taken to prevent binding the two together, as such a plan will destroy the outer wall near the top.

We find that some engineers believe that a lightning rod on a tall chimney is of no benefit, probably because a defective rod has not afforded full protection to some other chimney, but how are we to tell how many times a well laid rod prevents damage by lightning.

If it is carried well down into earth that is always moist it may carry off much of the dangerous fluid without making much fuss about it, hence it is some what like a good steam engineer, as neither gets full credit for the damage they prevent.

About a year ago an imposing chimney was built in a northern city, and when finished the scaffold used was taken down, but a few days ago workmen were said to be erecting another scaffold around that chimney, and investigation disclosed the fact that lightning had damaged the top of it, causing numerous cracks, but not displacing any of the bricks.

A short distance from it stands another chimney, above the top of which appears the points of two rods, and as this is a new one it is very plain to even the casual observer that the owners of it are profiting by the misfortunes of their neighbors to the extent of avoiding their mistakes.

When we consider the comparatively narrow or small dimensions of a chimney foundation, then compare it with its height, it becomes plain at once that a slight imperfection in the foundation, causing it to settle unevenly, although to a small extent, must affect the shaft to a much greater degree. It is both unpleasant and unsafe to have a tall chimney leaning to one side, therefore measures must be taken to correct the evil, and this can be accomplished by sawing out some of the bricks on the high side and putting thinner ones in their places. This allows the high side to settle, bringing the shaft into a vertical position, provided good judgment is used in reducing the size of the bricks, for if they are made too thin the effect might be disastrous, especially if the brick structure is surmounted by a heavy cap, which is needed to make the whole thing more solid, and thus prevent excessive swaying.

Another plan for plumbing a leaning chimney is to weight the high side of the foundation, or to puddle it until it settles enough to afford a remedy, but this is more dangerous than removing some of the bricks, for the simple reason that there is no way for telling just when the puddling has reached its highest state of perfection, making it risky to prolong the process.

Steel chimneys or stacks are no longer a novelty, which are so designed and constructed that no braces are necessary. The lower courses of such a chimney must, of necessity, be made of thick plates, in order to stand the heavy strain put upon them by bolting them down to a heavy masonry foundation, after which the pressure of wind against the upper parts causes a very great leverage to be brought to bear on the lower courses.

Such a chimney looks well and gives good results in practice, but it is more expensive than one supported by guys, because the absence of support to the upper parts makes a much more elaborate foundation necessary, also increases the cost of the lower part of the chimney itself.

A steel chimney or stack is less liable to be destroyed by accident than one composed of brick, as the latter cannot be held as rigidly together as one made of plates riveted to each other.

The larger sizes of steel chimneys are lined with fire brick, in order to prevent rapid destruction of the lower plates, and to retain the heat as much as possible, for if the hot gases are quickly cooled it tends to reduce the intensity of the draft.

More attention has been given to the design and construction of chimneys during the past few years than ever before, resulting in fine specimens of both steel and brick structures, that are ornamental as well as useful.—The Tradesman.

The Review of Madoc, Ont., states that owing to a number of accidents the electric light plant there has been closed down permanently, and that the citizens are in favor of taking steps to install a new plant.

STEAM VS. ELECTRICITY.

The Prussian State railways between Hamburg, Hanover and Berlin will shortly conduct an interesting competition between steam and electrically hauled trains. The leading locomotive builders and electrical firms of Germany have been invited by the State to submit designs and specifications for steam or electric locomotives or motor cars capable of making 100 miles an hour with a light load, and 90 miles an hour on ordinary traffic.

The tests will be a continuation of the trials of high speed electric trains on the Prussian standard guage military line between Berlin and Zossen, which have been arranged on account of the decision to increase the speed of trains between Hamburg, Hanover and Berlin.

Elaborate reports have just been published of the Berlin to Zossen tests. It must be borne in mind, however, that this is a line of only fourteen miles, and is practically staight, and without any curves of a radius less than 6560 feet and no gradient steeper than one in 200. In the first trials a car built at Cologne and electrically equipped by the Siemens-Halske Company of Berlin, attained for a very brief period a speed of 160.2 kilometres, or nearly 100 miles an hour, but the tests were abandoned owing to the giving away of the rails. They were too weak for the car, which weighed over ninety-two tons.

It is reported to be the intention of the Wiarton Electric Light Company, Wiarton, Ont., to install an incandescent system throughout the town.

The Shawinigan Water & Power Company, of Shawinigan Falls, Que., have closed a contract to supply power to the city of Sorel, Que. This will necessitate the building of a twenty-mile transmission line from Jolliette through the village of Laprairie to Sorel. From Lanorae the line will cross the St. Lawrence river by means of a submarine cable.

TO THE TRADE

WE are now in a position to fill orders promptly for Knife Switches of any size from 10 to 1000 Amperes. We have a modern up-to-date factory, using best methods, and making prompt deliveries. We solicit your trade.

The Hill Electric Switch Co., Limited, 426 St. Paul Street
MONTREAL

BELTING FOR ELECTRIC WORK.

The Rossendale Belting Company, Ltd., of Manchester, England, have opened a branch at Toronto, for the sale of their belting. The various productions of this company have for several years undergone severe tests in all kinds of work in the Dominion, and the quality of the goods has always been maintained.

The belt primarily adapted for electrical work is the "M. A. Y." brand. The following test was made by the Messrs. Galloways, Limited, at Manchester, on May 25th last :

			THICKNESS
No. 1 Test.—	5 in. Single Leather............	broke at 2,000 lbs.	¼ in.
" 2 "	5 in. Double Leather, copper sewn	" 4,500 lbs.	⅜ in.
" 3 "	5 in. Treble Leather, copper sewn	" 6,500 lbs.	½ in.
" 4 "	5 in. ROSSENDALE M.A.Y. BELT	" 10,200 lbs.	¼ in.

These belts will run under all conditions, exposed or damp places, heavy or light work, fast or slow speeds, main drives, etc.

SPARKS.

The town council of Renfrew, Ont., have passed a by-law to raise the sum of $88,390 for the purpose of acquiring the water power, dam and electric light plant of the Renfrew Power Company, Limited, and the Renfrew Electric Company.

The Stratford Gas & Electric Light Company, of Stratford, Ont., held their annual meeting early in August. The statement presented showed the past year to be the most successful yet experienced. Dr. S. A. King, of Windsor, was appointed president, and Mr. Baxter was re-elected managing director.

The Roberval Electric Company, Roberval, Que., have recently placed an order with J. C. Wilson & Company, Glenora, Ont., for a 28-inch deep bucket "Little Giant" turbine with horizontal mounting. The same firm have under construction a 12-inch wheel of the same type for J. A. Kirk, Arrowhead, B. C.

Messrs. A. Alabaster, Gatehouse & Company, 4 Ludgate Hill, London, E. C., have issued a valuable work entitled "Secondary Batteries." The main object of the writer has been to instruct persons in the work of attending to a storage battery. It is written by an engineer and contains numerous illustrations which serve to enlighten the reader.

The contract for building a power house for the Vancouver Power Company has been given to Jonathan Rogers. The power house will be built below the Trout Lake dam on the north arm of the inlet, and will be a stone building 40 x 156 feet. The wall will be 30 feet in height and 2½ feet in thickness. The company expect to have 4,000 horse power available by the end of the year.

Since the 1st of May, when J. C. Wilson & Company, Glenora, Ont., manufacturers of the Little Giant turbine, reported their foreign shipments as twenty-one turbines, they have shipped the following additional wheels, namely, two 12-inch, one 21-inch, one 28-inch, and one 44-inch, all of the vertical style. They also have under construction, to go abroad, one 14-inch, one 21-inch and one 24-inch.

The electric light committee have presented to the town council of Almonte, Ont., a report regarding improvements to the electric light plant. The first proposition is to lower the present wheel and build new frame and bulkhead, at a cost of $4,800. Another proposition is to build a new power house, including open waterway and new bulkheads and dynamo, at an approximate cost of $12,000. Still another proposition calls for an expenditure of about $25,000 on improvements and new plant.

The Peterborough Hydraulic Power Company, of which Senator Geo. A. Cox is president, is building a new power plant on the Otonabee river, in the Town of Peterborough, which will be equipped with the following apparatus recently purchased from the Westinghouse Electric & Manufacturing Company : A 1500 kilowatt, 2240 volt generator, having 7200 alternations and running at 150 revolutions per minute, to be direct connected to water wheels ; also two 125 volt, D. C., direct coupled exciters of 75 kilowatts capacity each ; together with switchboard consisting of a large generator panel and two exciter panels. This power house, when completed, will be an unusually fine one and is to furnish power to the Peterborough mill of the American Cereal Company, owned by the Quaker Oats Company ; power will be supplied to several other manufacturing plants in the town and also to the Peterborough Light & Power Company, which does an electric lighting and small power business in Peterborough.

CHANDLER CANADIAN PATENT NO. 63721

We are prepared to receive
orders for the manufacture of

ENGINES

covered by the above
patent ❧ ❧ ❧ ❧ ❧

Laurie Engine Company
Montreal, Canada

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. SEPTEMBER, 1903 No. 9.

THE POWER PLANT OF THE OTTAWA ELECTRIC RAILWAY.

By John Murphy.

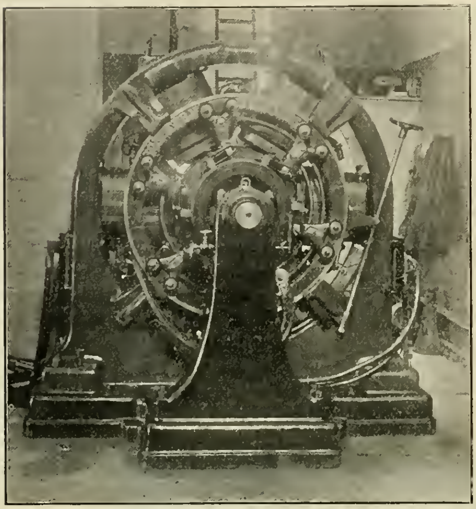
To visit the power house of the Ottawa Electric Railway Company is to be impressed with the conviction that the company's street car system is a model one in every particular. While much could be said about the cheerful, bright and clean cars, the natty and polite employees, and the excellent condition in which the whole equipment is kept, the purpose of this article is merely to describe that part of the system which so quickly excites public interest if it happens to get out of order—namely, the power station.

The Ottawa Electric Railway Company—Battery Room in Power House.

Before the memorable fire of April 29th, 1900, which destroyed the greater part of Hull and a large portion of the City of Ottawa, the power plant of the Ottawa Electric Railway Company consisted of two hydro-electric stations containing five Westinghouse generators. Of the latter four were belt-driven four-pole machines, and one was a twelve pole direct-connected machine. The combined output of the belted-driven machines was 2100 h.p., and the output of the other was 2000 h.p. The two stations were situated side by side and either was capable of supplying energy for the whole service. The belt-driven generators were installed in an iron-covered frame building of exceptionally rigid construction and the more modern outfit was contained in a fire-proof brick and steel structure. The latter unit was intended to preclude the possibility of a complete tie-up in the event of an accident to the other plant, as well as to provide for extensions of the service, and while its installation was in progress one of the belt-driven machines, a 700 h.p. generator, was removed to the auxiliary steam station of The Ottawa Electric Company, about a quarter of a mile distant, where it still remains. The fire of April 26th, 1900, completely destroyed the building containing the belt-driven generators, but the new station was practically uninjured. The steam station also escaped destruction, as it occupied a comparatively isolated position.

In the Fall of 1902 a building was erected on the site of the destroyed station, in which there was installed and there is now in operation the largest storage battery in Canada. It consists of 288 cells of the Electric Storage Battery Company's latest improved chloride accumulators. The elements of the battery are contained in lead-lined wooden tanks which have been made large enough to permit of a 50 per cent. increase in the number of plates and in the output of the battery. Each tank now contains twenty-five type G plates, but there is space in each for thirty-nine plates. The tanks rest upon porcelain insulators supported by well seasoned pine stringers suitably waterproofed, and the stringers are separated from the concrete floor of the room by vitrified bricks. This arrangement keeps the battery thoroughly insulated from the ground.

The maximum discharging and charging rates of the battery are 1000 amperes and 350 amperes respectively. As the battery is thus able to take care of load changes amounting to 1350 amperes, and as the Ottawa Electric Railway's fluctuations in load are much less than this amount, the generator load is an absolutely constant quantity.

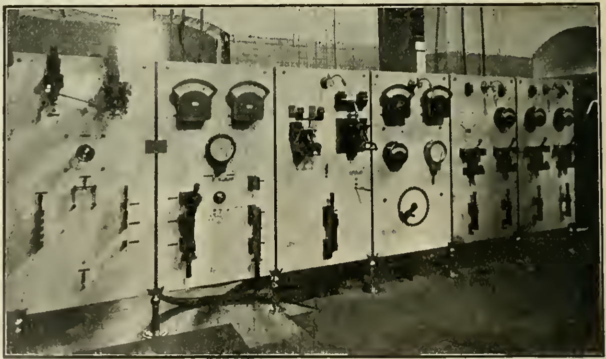


THE OTTAWA ELECTRIC COMPANY — MOTOR-DRIVEN BOOSTER.

It was only after a thorough canvas of the situation that the Ottawa Electric Railway Company decided to install the battery. The company foresaw that in the event of an accident to a water wheel, to a gate, or to the gate-moving mechanism on their direct-connected unit their entire car service would be dependent upon the services of the 700 h.p. steam-driven generator, and to avoid such a contingency additional power plant became a necessity. However, before reaching a decision the question to be solved was this: Which installation would give the best results—a steam-driven generator, a water-driven generator, or a storage battery? The steam plant's first cost and expensive operation were serious barriers to its installation, and the hydro-electric equipment's inability to render assistance at times when it would be most needed, namely, during ice or low water troubles, had much to do with preventing its selection. In the end the battery was decided upon because it would immediately improve the service by maintaining constant e.m.f. at the power house, irrespective of load changes, and for the further reason that it would prolong the life of the hydraulic outfit not only by relieving the water wheels and gates from the jars occasioned by sudden variations in load, but also by saving the gate mechanism from being destroyed through its constant moving back and forth. A further and very important factor in determining the selection of the battery was that it would also act as additional plant. As is well known, street railway loads are of a fluctuating character, and peak hours exist. Thus it happens that between midnight and morning battery charging can always be done and power thus stored during the night can be reserved for times of need. In connection with the generator at the steam station the battery is also able to take care of a respectable limited service.

The beneficial results obtained from the Ottawa Electric Railway Company's battery during the past seven months are so apparent that the management have good cause to congratulate themselves on the wisdom of their choice. Up to the time the battery was installed the water wheel speed and consequent generator e.m.f. was controlled by hand. The controller's efforts met with the degree of success which is illustrated by the recording voltmeter chart No. I. The 550 volt line was aimed at on this chart, but an average of about 520 volts was obtained, while sudden voltage jumps of twenty per cent. were not uncommon. Cars at distant points received about one-half normal voltage when the power house voltage dropped, because the consequent rise in current which accompanied the fall in voltage introduced abnormal line losses—the process being a cumulative one.

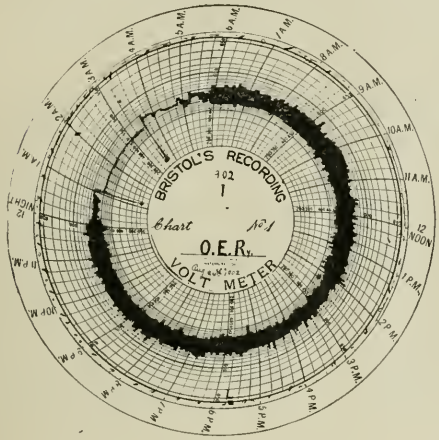
A glance at chart No. II will serve to indicate what the battery daily accomplishes in the way of regulating the bus-bar voltage and generator speed. In fact, a comparison of charts I and II is one of the greatest object lessons ever published. Chart I was made before the battery was installed, chart II afterwards. Chart I illustrates wide speed and voltage variations which occurred despite the constant efforts of faithful attendants to prevent them. Chart II shows what is now done automatically and without the slightest waste of energy in its accomplishment. Both charts were made by the same voltmeter connected across the power house bus-bars. Many lighting plants are operated to-day whose voltage curves would not favorably compare with the Ottawa Electric Railway Company's chart No. II.



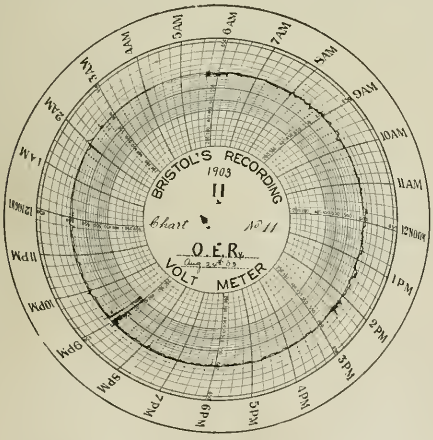
THE OTTAWA ELECTRIC RAILWAY COMPANY—SWITCHBOARD.

The potential and current curves taken down from Weston instruments by two attendants whose actions were kept in synchronism by the bell on a metronome also present a striking illustration of the former and present operating conditions of the plant in question.

It will be noticed that the normal power house pressure is now 600 volts. The generator's speed and its field charge were both increased slightly to obtain this pressure. The pressure was raised to 600 volts for the purpose of obtaining the many benefits available when working at this point and also because it was felt that the battery would hold the pressure constant at whatever point was decided upon. Chart II shows that a variation from the zero point of more than 1½ per cent. is a rare occurrence. The vim with which the cars now ascend grades and the way in which they spring to life when the motorman moves his controller are among the most gratifying improvements that have followed the installation of the battery.



The reduction in the amount of current used per car due to the increased voltage is also a feature worthy of special attention. The power house current output, with the same number of cars in operation, has been reduced 40 per. cent ! The average amount of current used per car, based on power house indications, under old conditions was 28 amperes—it is now 17 amperes. The reduction in line losses on this account is a most important matter, as it will postpone for a long period the necessity of increasing the feeders throughout the system. A differentially wound motor-driven booster works in connection with the battery, and it makes the latter so sensitively active that an absolutely constant load is kept on the generator. The water wheel gates are not moved at all for the purpose of speed regulation ! The gates are opened far enough to make the generator carry the average load and the closest inspection of the tachometer fails to reveal any speed variation. A visitor could easily be persuaded that the generator was supplying an incandescent lighting service, so smoothly does it operate. An inspection of the line and battery ammeters, however, indicates that large and rapid changes are always taking place.



The present plant, consisting of direct-connected generator and battery, is capable of supplying energy to a much greater number of cars than are ever used in Ottawa, and with the steam station a large amount of reserve power is always available. The illustrations represent the booster, the switchboard and the battery room. It is interesting to note, in the switchboard picture, that while the battery and bus voltmeter needles are reproduced quite clearly the ammeter needles are not printed at all—the latter do not remain in one position long enough to be photographed.

MR. JAMES FERNS.

Mr. James Ferns, who succeeds the late Mr. F. H. Badger as Superintendent of the Montreal Fire Alarm Department, was born in Montreal, March 10th, 1854. After a successful commercial course, he entered the service of the Fire Alarm Department in June, 1866. His first study was to master operating, in which he became remarkably expert, being able to use either the Morse or Bain alphabets with equal facility, the Bain at that time being generally used in fire alarm offices. Under the instruction of the late superintendent every opportunity was afforded for intricate testing, and Mr. Ferns soon became proficient in matters electrical. Practically for the last five years he has had charge of the fire alarm system, and many of his inventions are now giving the greatest satisfaction in the fire alarm office. He also made practical the first invention for unhitching horses in fire stations by electricity.

MR. JAMES FERNS,
Superintendent Montreal Fire Alarm Department.

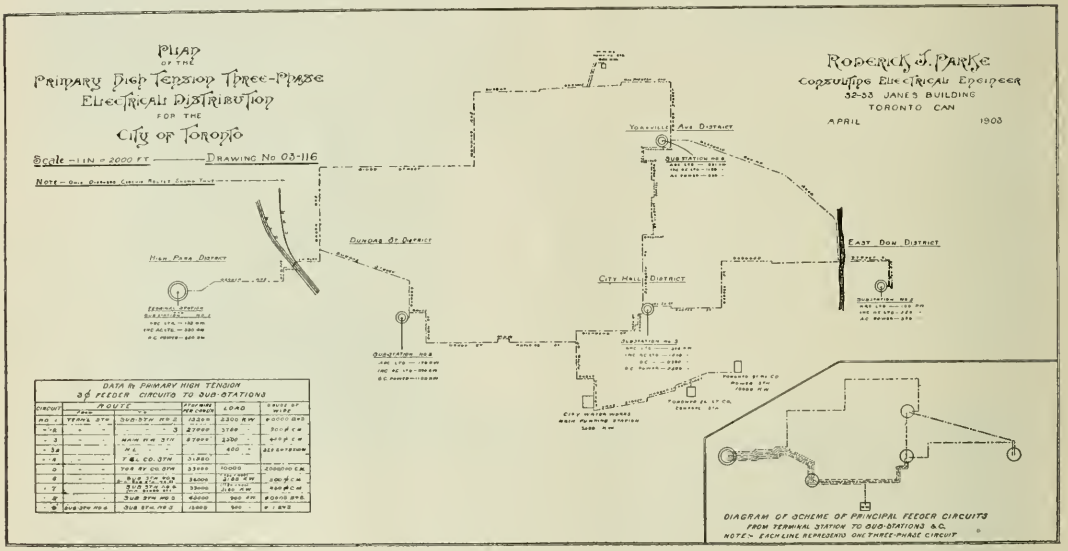
Since his appointment as superintendent the system is undergoing extensive improvement and alteration. It is his intention to visit the leading United States cities this fall, looking for ideas for further improvements. We wish him every success in his new position.

ELECTRIC POWER FOR TORONTO.

Last spring Mr. C. H. Rust, City Engineer of Toronto, was requested to report to the city council as to the estimated cost of developing electric power at Niagara Falls and transmitting it to and distributing it within the city. Accordingly, he engaged Mr. R. J. Parke, E.E., to prepare a report on the cost of distribution within the city, and also consulted Mr. Alex. Dow, manager of the Edison Illuminating Company, Detroit, regarding the matter. The reports of these gentlemen, which are printed in part below, are of interest to electrical men as well as to the citizens of Toronto. It was not considered necessary to go more in detail into the question than has been done. The curves accompanying Mr. Parke's report were worked out on the basis of the report. Curves 1 to 5 inclusive, not shown, are curves of the various sub-station service loads for December.

REPORT OF R. J. PARKE.

Acting on your instructions which I received on February 28th last, I have made a careful survey of the city in order to ascertain the amount of power required for electric lighting and motive power services throughout the city. I submit herewith an estimate of the amount of power, the capital cost of a municipal plant for the purpose of distributing the said power throughout the city, and an estimate of the annual cost of operating such a plant.


PLAN OF THE PRIMARY HIGH TENSION THREE-PHASE ELECTRICAL DISTRIBUTION FOR THE CITY OF TORONTO
Scale – 1 IN = 2000 FT
DRAWING No 03-116
NOTE – Only Overhead Circuit Routes Shown Thus
RODERICK J. PARKE
CONSULTING ELECTRICAL ENGINEER
32-33 JANES BUILDING
TORONTO CAN
APRIL 1903
HIGH PARK DISTRICT
TERMINAL STATION AND SUBSTATION NO. 1
DUNDAS ST DISTRICT
SUBSTATION NO. 2
YORKVILLE AVE DISTRICT
CITY HALL DISTRICT
SUBSTATION NO. 3
EAST DON DISTRICT
CITY WATER WORKS MAIN PUMPING STATION
TORONTO EL. LT. CO.
TORONTO ST. RY. CO. POWER STN
DATA re PRIMARY HIGH TENSION 3φ FEEDER CIRCUITS TO SUB-STATIONS
CIRCUIT
ROUTE
FROM
TO
LOAD
GAUGE OF WIRE
DIAGRAM OF SCHEME OF PRINCIPAL FEEDER CIRCUITS FROM TERMINAL STATION TO SUB-STATIONS &C.
NOTE:– EACH LINE REPRESENTS ONE THREE-PHASE CIRCUIT

This estimate is arranged into three main divisions, namely :

Estimate of power for various public services.

Capital cost of distribution plant.

Operating expenses of the above-mentioned plant.

For the purpose of this estimate, I assume that power will be delivered at some suitably convenient point on the western city limits, by transmission line delivering 3-phase alternating current at from 30,000 to 60,000 volts E.M.F., and 60 cycles frequency. I have chosen for this point a location in High Park near the junction of Garden avenue and Indian road. This location would be the site of the main receiving station hereinafter referred to as the terminal station. From the terminal station power will be distributed by means of 3-phase alternating current over-head circuits, of suitable voltage, to the various sub-stations throughout the city, all as shown on drawing No. 03-116 herewith.

ESTIMATE OF POWER REQUIRED.

The amount of power required for each of the respective services given below, is as follows :

Street lighting	950 K.W.
Incandescent alternating current lighting	2,500 K.W.
Incandescent direct current lighting	2,400 K.W.
Alternating current motive power	1,700 K.W.
Direct current motive power	3,300 K.W.
Main W.W. pumping station power	2,500 K.W.
H.L. W.W. pumping station power	400 K.W.
Total	13,750 K.W.

The above total does not represent the load at the terminal station because the maximum loads in certain districts are thrown upon the terminal station at a time when other loads are on a decline, consequently the load which would likely be thrown on the terminal station by all the services would not likely exceed 10,000 k. w., which would be about the amount of power to be charged for at this point by the producers.

To the above, however, should be added the estimated load of the Toronto Street Railway, which would be approximately 10,000 k. w., making the entire load upon the sub-station equal to 20,000 k. w. as a maximum.

CAPITAL COST.

STATION EQUIPMENTS :	
Terminal station, high voltage side	$230,000.00
Terminal station No. 1, sub-station side	20,400.00
No. 2 sub-station	101,000.00
No. 3 sub-station	160,000.00
No. 4 sub-station	35,100.00
No. 5 sub-station	19,500.00
Total	$566,000.00
Buildings	$ 70,000.00
Underground distribution system	566,559.00
Overhead distribution system	483,082.00
Engineering, supervision and contingencies	100,000.00
Total cost	$1,785,641.00

OPERATING EXPENSES.

FIXED CHARGES :	
Interest on Bonds at 3.75 per cent	$ 66,961.00
Sinking and Depreciation Fund at 7%	124,994.00
VARIABLE CHARGES :	
Operating staff	62,000.00
Repairs, supplies, etc., chargeable to maintenance	30,000.00
Total annual expenses	$283,955.00

If the current be delivered at 30 cycles or 25 cycles instead of 60 cycles the sum of approximately $150,000 will have to be added to the above estimate for apparatus for raising the frequency to 60 cycles in order to operate incandescent alternating current lighting and the street lighting system.

The above estimates can be reduced by about 25 per cent. if a plant suitable for only immediate requirements be contemplated.

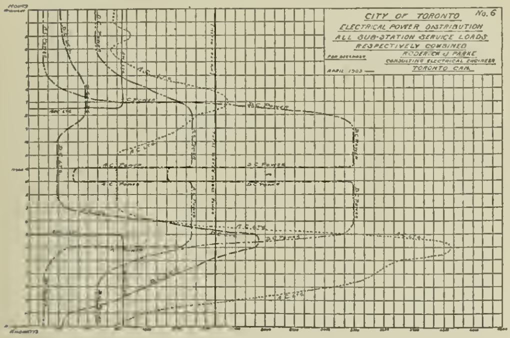
The above estimate covers the capital cost of a plant suitable for the probable requirements of the next five years.

REPORT OF ALEX. DOW.

The following figures are based on the premises as set forth in Mr. R. J. Parke's report of May 1st, namely, that a maximum of 10,000 kilowatts capacity at the city limits will permit the connection of different classes of business aggregating 13,750 kilowatts. I think that this assumption by Mr. Parke is justified.

OWNERSHIP OF TRANSMISSION LINE.

A line and right of way such as would be advisable would cost between $700,000 and $1,000,000. The difference is partly the difference in distance between the two powers under consideration, to wit, Jordan and Niagara, and is to some extent a matter of detail of construction depending on factors which are not now before us. The maintenance of such a line, to wit, the constant patrolling required and the making of ordinary repairs. will cost from $10,000 to $12,000 per year. Interest on the investment being assumed at 3.75 per cent. and depreciation and sinking fund assumed at 5 per cent., would give a total annual cost of transmission line of, say $100,000.



It is to be noted, however, that such a line would take care of twice the capacity at which it is now proposed to load it. I do not think it wise to build a line for the exact capacity required. The cost would not be proportionately reduced because the expense for right of way, for poles, cross-arms and fittings would be identical in either case, the only increase being in the amount of copper. It appears to me that under those circumstances the development of the business should be provided for in the first investment in transmission lines. It is to be noted also that if copper is used the metal is always a good asset. I assume also that the right of way will be a good asset.

The figures submitted by the Hamilton & Lake Erie Power Company for power at Jordan and for power at Toronto city limits differ by $10 per horse power of capacity required. This is, however, not a net difference, because the city will require to purchase at a maximum say 15 per cent. more power at Jordan than it would require to purchase at the city limits to make good the loss in transmission. Under the present conditions, therefore, the saving to the city by owning its own transmission line would not be great, but any increase of power sold in Toronto up to the capacity of the line would directly increase the saving. A line such as I have estimated will take care of 20,000 kilowatts. If that load should be attained the city would be saving $130,000 per annum.

I have taken safe figures in making this statement. I may add to it that it strikes me that the Hamilton & Lake Erie Power Company do not want to build that line or they would have made a less difference in the price of power at Jordan and power at the city.

COST PER HORSE POWER AT CITY LIMITS.

Assuming your figure of $10 per horse power at Niagara Falls or at Jordan, there must be added to this 15 per cent. for the energy expended in the transmission line. There must also be added a pro rata of the annual cost of the transmission line; 10,000 kilowatts is equal to 13,400 horse power. As follows :

TABLE NO. 1.

Cost per horse-power generated...	$10.00
15 per cent. transmission loss...........	1.50
Pro rata of cost of transmission line....	7.46
Total	$18.96

But this is the condition if the entire annual cost of the transmission line is charged to the present business. The transmission line is fit to take care of twice the present business. Assuming that the business has been increased 50 per cent. we have the following :

TABLE NO. 2.

Cost per horse-power generated........	$10.00
15 per cent. transmission loss...........	1.50
Pro rata of cost of transmission line....	4.98
Total	$16.48

Mr. Parke estimates that the addition of the business of the Toronto Street Railway Company would double the work on the transmission line. It would be good policy both for the City and the Street Railway Company to combine their demands at least as far as the city limits. The same reasons which warrant the construction of a line having more capacity than the immediate demand would dictate this conclusion. Assume that this business is added and your figures are as follows :

TABLE NO. 3.

Cost per horse-power generated	$10.00
15 per cent. transmission line...........	1.50
Pro rata of cost of transmission line.....	3.73
Total	$15.23

If the Street Railway Company should require power it would naturally take delivery of that power at the city limits, and the above figures should be taken as a guide in fixing the price. Even if power should be furnished to the railway company at cost, it is evident that their use of the same transmission line would bring down the average price of power to all consumers.

COST OF POWER DISTRIBUTED.

Because the different demands for power do not coincide in time, Mr. Parke has (I believe correctly) estimated that with a maximum of 10,000 kilowatts (13,400 horse-power) at the city limits, services to a total of 13,750 kilowatt hours (18,425 horse-power) can be provided for. He estimates the total annual expense of distribution (including a high charge for depreciation and sinking fund) at $283,955. There will be certain electrical losses in distribution whereby it will result that more power will be required at the city limits than will be accounted for by the customers' meters or be chargeable to customers under a contract system if meters are not used. Meter slip—that is to say, the amount of energy which customers' meters fail to record—is the largest single item of this loss. The next largest is the conversion loss from alternating to direct current which is necessary to provide for the incandescent direct current lighting and direct current motive power. After careful consideration the total distribution loss can be provided for by adding to the cost of energy received at the city limits 20 per cent.

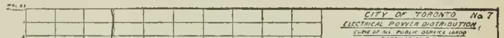


TABLE NO. 4.

Cost per horse-power at city limits, maximum figure :	
Table No. 1......	$18.96
Add 20 per cent. for distribution losses..	3.79
Add expense of distribution per Mr. Parke's estimate..................	15.41
Total	$38.16

It results that the city should receive an average figure for power distributed by it sufficiently in excess of $38.16 per h.p. per annum to prevent any possibility of loss.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY
THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2290.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.

1ST VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

2ND VICE-PRESIDENT:
A. A. WRIGHT, M. P., President Electric Light & Power Co. Renfrew, Ont.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.
K. B. THORNTON, Montreal Light Heat and Power Co., Montreal, Que.
A. A. WRIGHT, M. P., President Electric Light & Power Co., Renfrew, Ont.
JOHN VULE, Manager Guelph Light & Power Co., Guelph, Ont.
A B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
A. A DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
GORDON HENDERSON, Supt. Cataract Power Co. Hamilton, Ont.
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.
C. K. GREEN, Superintendent Hamilton, Grimsby and Beamsville Electric Railway, Hamilton, Ont
CHARLES B. HUNT, Manager London Electric Co., London, Ont.
J. A. KAMMERER, Director Cataract Power Co., Hamilton.
H. O. FISK, Superintendent Peterborough Light & Power Co., Peterborough, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, F. W. DONALDSON, - -	Toronto
Vice-President, CHAS. MOSELEV, -	Toronto.
Treasurer, A. M. WICKENS, - -	Toronto.
Registrar, J. G. BAIN, - - -	113 Yorkville Ave., Toronto
Solicitor, H. CARSCALLEN, - -	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler.
BRANTFORD.—A Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

Information regarding examinations will be furnished on application to any member of the Board.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, W. OELSCHLAGER -	Baden, Ont.
Vice-President, H. E. TERRV,	Toronto, Ont.
Secretary, W INGLIS, - -	Toronto, Ont.
Treasurer, J. IRONSIDES,	Hamilton, Ont
Conductor, J. STRUTHERS, -	Sarnia, Ont.
Door Keeper N. BEAN, -	Waterloo, Ont

Switchboards. The appearance and location of the switchboard equipment of the average small plant would lead the casual visitor to believe that this part of the installation was but a minor and unimportant item, whereas if the truth were recognized it would be seen that such is far from being the case. Continuity of service is the one and paramount desideratum of operation, but this cannot be expected unless all parts of the equipment are kept in proper shape. That this is not done is evidenced by the nondescript appearance which the switchboard so often bears, wooden boards, boards with broken switches, open lead fuses, spacings between bare parts which are scarcely fit for 200 volts, let alone 2000 which is frequently the potential obtaining, boards with neither lightning arresters nor ground detectors—the list might be extended almost indefinitely. Then again, the matter is frequently made worse by crowding the equipment, good bad or indifferent, into a corner containing barely half the necessary room and giving every chance for the accumulation of station refuse and every excuse for the want of attention on the part of the attendant. Good reliable switchboards, equipped with tried and proven devices, are now standardized by all manufacturers and thus can be quoted at prices considerably below those prevailing a few years ago. Surely it will pay any and all plants to see that this part of their equipment is strictly up to date, especially when the expenditure can be looked at as one form of insurance against not only interruptions to the service, but also a possible total destruction of the plant.

Multiphase Transformers. The European manufacturers of electrical apparatus have for many years advocated and sold multiphase transformers, but the practice on this side has always inclined to the use of single phase apparatus. Just as the copper of three single phase transmission lines can be amalgamated to form one single three phase line of increased capacity, so the iron and copper of three separate transformers, if made into a multiphase equipment, can be used to produce a considerably larger output. It is therefore peculiarly interesting to see that the General Electric Company, who have for long been one of the principal upholders of single phase transformers, are now publicly advocating three phase and six phase equipments, and thus are adopting the ideas of Continental engineers. The converse of increased output by combining three single phase transformers into one three phase is of course the production of a given output more cheaply by the use of three phase than of single phase equipments. This means that one transformer, containing in its case the necessary cores and windings for a three phase or six phase circuit, would cost less and weigh less than three single phase equipments. Further than this, it has other advantages which may perhaps be of even greater weight, namely, greater ease in handling and installing, especially on poles, improved appearance, decreased floor or pole space and also less complication in the wiring required. It will at once be recognised that this is a large list of strong points, and now that one of the largest manufacturers on this continent has commenced to quote on the type, it is to be expected that the example will be followed by many other producers and that consequently installations of this class of apparatus will become as common in the future as they have been infrequent in the past.

Wiring Methods and Material.

We have previously had occasion to call attention to the crying need for improvement in the way in which electrical machinery and wiring is often installed, but the frequency with which cases of criminally careless work come to light, let alone those which at the best are but botchwork, would seem to indicate that the matter is in many cases being entirely lost sight of. As an example we would cite an installation which recently came under our notice in which a 2200 volt line was carried into the basement of a building, no lighter and no dryer than basements usually are, with ordinary weatherproof wire, run on knobs. At several points it had been necessary to insert connectors, parts of which extended to within two or three inches of each other and were not even taped over, notwithstanding that they were within easy reach of anybody passing, being but four or five feet from the floor. Further than this, ordinary lead composition fuse wire, bare, was in use. Compare the above with a proper equipment of rubber wire and enclosed fuses, the former run in conduit and the latter with their necessary connectors and mountings boxed in cabinets, and you will have some idea of its shortcomings. At another installation, a woollen mill, with its usual contents of highly inflammable material occupying all parts of the building, to say nothing of the lint and dust which invariably accompany such processes, there was found the old familiar open lead fuse, some in cutouts with porcelain covers and some without even this slight protection. This meant that the blowing of one of them was almost certain to ignite the pile of material immediately below it, with ultimate results which can easily be imagined. Proper enclosed fuses, installed in cabinets, would have cost but a trifle more and would have made a fire of electrical origin a remote possibility, instead of a large probability. Is it any wonder that when work such as found in the above instances is allowed to be put in, that the uninformed public, and for that matter, many who claim to be well posted, look askance at the proposal to introduce electric power. In the former of these cases the installation was a positive menace to life, and both offered every chance for a severe fire, the reports of which, spread far and wide the country over, would contain but one theme, the great fire risk from all electric wires and machinery.

Converting Alternating Into Direct Current.

The comparative simplicity with which an alternating current of any given pressure can be changed to any other desired potential gives this form of electric distribution great advantages over direct current systems, but it is frequently found that the latter is absolutely necessary for some of the processes involved, such as electro-chemical work, election traction, or for the charging of storage batteries. This has naturally made a demand for some form of apparatus which will change the one into the other, several types of which have consequently been developed. Perhaps the earliest device and the most widely used, consists of the familiar motor-generator set, composed of an alternating motor, either synchronous or induction, driving a direct current generator. Compared with all the other methods of accomplishing the desired result this has the great advantage of giving a wide range in the direct current voltage, in addition to which the latter circuit is entirely separate from the alternating supply. The main shortcoming is that both the motor and generator have each to be of a kilowatt capacity equal to that of the output, which means greater cost and somewhat less efficiency, seeing that there are losses in two machines instead of one. The result of the effort to overcome these defects was the rotary converter, a machine, always of the revolving armature type, provided with both a commutator and a set of collector rings, which takes the alternating current in at one end and gives it out as direct at the other. This means smaller and therefore less costly machinery, of higher efficiency, but the two circuits are not insulated from each other, nor is there much opportunity to vary the direct current voltage, as it bears a certain ratio to the alternating potential supplied, which ratio is fixed by the design of the apparatus. Futher than this, in almost all cases static transformers have to be supplied to give the required alternating potential.

A device of radically different design from either of the foregoing is the Leblanc rectifier, which consists of a rotating commutator actuated by a small motor. This latter is driven by the alternating current to be rectified and as a consequence the speed of the commutator keeps in step or synchronism with each half wave, reversing it just at the proper instant and thus producing a direct current. The apparatus is quite efficient, there being practically no losses other than those due to friction, but so far its development has been hindered by the heavy sparking which appears to be insurmountable. The converse of the Leblanc rectifier, in which the commutator revolves, is the stationary commutator supplied from a ring wound coil, which is energized from a multiphase circuit, and thus contains a rotating magnetic field. A set of rotating brushes bear on the commutator and collect direct current from it.

Still another style is the electrolytic. A cell of platinum and iron, for instance, will pass a current in one direction only, opposing the other half of the wave. By a suitable combination of cells both halves can be utilized to form a direct current. To the same class belongs the recent discovery of Mr. Hewitt, who utilizes mercury vapor as the conducting medium, instead of the iron-platinum cell. It is not yet definitely known just what his apparatus is capable of doing, but so far the indications are that it has a very large field in front of it, being highly efficient and at the same time much less costly than the other types.

While a 300 horse power Wheelock engine was being installed in the municipal electric light station at Midland, Ont., Henry Chester was caught between one of the blocks and the engine and his leg broken. Another workman, Samuel Warner, called for assistance for Chester, and immediately after doing so expired himself, death probably being due to heart failure caused by the shock.

Dr. Haanel, Superintendent of Mines, Ottawa, was one of a Government Commission which recently investigated a process for the treatment of magnetic iron ores by electric smelting, the invention of Prof. Ruthenberg. Specimens of product taken during a trial run at Lockport, N. Y., are now in the hands of the assayer, and a report will shortly be made to the Minister of the Interior.

EXHIBITS IN MACHINERY HALL AT TORONTO EXHIBITION.

"Better than past years" is the almost unanimous verdict of persons who have inspected the exhibits in the Machinery Hall at the Toronto Exhibition now in progress. This year there are several new exhibitors, while one or two who were represented last year are missing. There is general complaint that the accommodation provided by the building is inadequate, which may account for the fact that some of the largest Canadian manufacturers do not exhibit.

The largest exhibitor in the Hall is the Canada Foundry Company, who occupy a space 12 x 128 feet on the south side of the building. There are shown three centrifugal pumps in operation, each discharging about 200 gallons per minute. A full line of boiler feed pumps, a large sinking pump for mining purposes, and outside pack plungers complete the display in this department. Their gasoline engines are shown in a range from 1½ to 7 horse power. A feature of the exhibit is the Curtis electric truck, one of a large order for the Toronto Railway Company, and we understand that they have just completed a large order for the Winnipeg Street Railway. The truck is a swing motor truck, the bolster being carried on full elliptical springs. The truck frame is supported by four coil springs at each pedestal. A full line of water pipes, valves, hydrants, drinking fountains and ornamental iron work, including a large gate said to be the heaviest grille work ever made in Canada, complete the display, which is lighted in a brilliant manner by the Canadian General Electric Company's latest type of multiple alternating current arc lamps. The exhibit is in charge of Mr. H. O. Edwards.

The United Electric Company, Toronto, exhibit a 40 k. w. 250 volt dynamo, a duplicate of the machine installed in the Toronto City Hall, a 30 k.w. multipolar 250 volt machine operated by a Bell engine, two bipolar machines, one 25 and the other 15 k.w., 125 volts, a 75 k.w. "Superior type" induction alternator, a 25 h. p. induction motor, and several bipolar and and multipolar motors, together with complete switchboard equipment, including Whitney instruments and standard high tension switches. As a special feature they show a switchboard for an engine room of a steam yacht. It is fitted with seven distribution switches, two 3-pole main switches, Ward-Leonard Electric Company rheostats and Whitney instruments, all mounted on Tennessee marble. The board is 4 feet by 2½ feet and of high-class finish.

In the space occupied by the Jones & Moore Electric Company, Toronto, is found a Goldie & McCulloch "Ideal" engine operating one 40 h. p. and one 75 h. p., 125-volt generators, and a line of multipolar and bipolar machines connected up. They supply arc and incandescent lighting throughout the Machinery Hall. Their switchboards are equipped with quick-break switches, which prove very effective. Arc lamps for alternating current, 110 volts, and for series, are shown, also telephone instruments and electric fans. One of their ¼ h. p. motors operates the exhibit of the Henderson Roller Bearing Company with comparative ease.

Among the many attractive exhibits is that of the Rogers Electric Company, Toronto, who show electric and combination fixtures, electric fans, telephones, switches and electrical supplies generally. Their Japanese art domes for electric lights are unique, a particularly pretty one being of Pompeiian green in tiffany finish, the trade price being $250.

The Toronto & Hamilton Electric Company, of Hamilton, are again conspicuous by a display of generators and polyphase and induction motors, switchboards, arc lamps, etc. They have recently placed on the market a line of polyphase motors of two and three phases which are meeting with a large demand.

"King Edward" dynamos and motors are exhibited by the Consolidated Electric Company, Toronto. A 25 h. p. dynamo is supplying current for only one lamp, but notwithstanding such an unfavorable condition there is apparently little or no waste of current.

The exhibit of the Goldie & McCulloch Company, Galt, is this year larger than usual. One of their "Ideal" engines of 90 h. p. drives a line of shafting on the south side of the building, and a 100 h. p. Wheelock engine drives the shafting on the north side. They show several wood and iron working machines, including a railway cut-off saw, No. 18 planer, No. 9 planer and No. 0 moulder, also gyrators and Philbrick patent matcher heads.

Mr. William Bennett, of Sunderland, Ont., has in operation a one-cylinder engine, claimed to be the only engine of this type in successful operation in the world. The steam is compounded in high pressure temperature, high and low pressure steam being used in one and the same cylinder continuously and alternately.

Babcock & Wilcox, Limited, Montreal and Toronto, are new exhibitors this year, and they have the honor of showing the only boiler in the building. It is one of their well-known water tube type, of 20 h. p. and carrying 130 pounds of steam. They have just installed two boilers of 500 horse power for the Toronto Street Railway, and two more are on order for installation early this fall. They have also secured the contract for 750 horse power for the King Edward Hotel in this city. The Toronto office of the company is at 114 King Street west, in charge of Mr. A. C. Larkin.

Power transmission machinery and shafting are exhibited by the Dodge Manufacturing Company, Toronto. They show a rope drive driving down to a jack shaft with friction clutch attached, automatic friction winches, wood-split pulleys, iron centre wood rim pulleys, bearings, hangers, etc., and a railing of steel shafting with clutches and pulleys attached. The business of this company is growing very rapidly, their goods being now in use for almost every conceivable purpose.

The Philip-Carey Manufacturing Company, 100 Front street east, Toronto, make a fine showing of their 85½ per cent. magnesia pipe and boiler covering, which is claimed to have the highest efficiency of any covering on the market. Locomotive lagging, asbestos packing and magnesia flexible roofing cement are included in the line of goods shown.

Many favorable remarks were heard concerning the exhibit of the James Morrison Brass Manufacturing Company, of Toronto. The arrangement is artistic and makes a very striking effect. The goods shown include the well-known "J.M.T." injectors and valves, the Ohio injector, Locomotive monitor injectors, Heintz steam traps, Hancock inspirators, phosphor bronze valves for pulp mills, pop safety valves, steam gauges, repeating steamship telegraph gongs, gong bells and oil cups, together with a large and varied assortment of beautiful electric fixtures, the whole "Made in Canada."

The Canada Metal Company, Toronto, have a very creditable showing, the goods including a full line of babbitt metals of all grades, wire solder, battery zincs, antimony, phosphor tin, and fuse wire, the company claiming to be the only manufacturers of fuse wire in Canada. The visitor is attracted by a large figure of a man surmounting the stand, made entirely of metal.

A range of gas and gasoline engines from 3 h.p. to 25 h.p. is exhibited by the Goold, Shapley & Muir Company, of Brantford, Ont. One of these engines is fitted with a combination attachment by which it can be changed from gas to gasoline, and vice versa, without stopping the engine.

Engineers' supplies are shown by the Hamilton Manufacturing Company, Toronto. They include metallic high grade engine and pump packings, steam flue blowers designed to prevent waste of steam, "Perfect" oil filters and "Neverslip" pulley coverings.

Mineral wool in its crude form and after being manufactured is shown by the Eureka Mineral Wool Company, of Toronto. Mineral wool is made by converting scoria and certain rocks while in a melted condition to a fibrous state. It is also made from blast furnace slag, the molten slag being blown into a fibrous condition by the action of steam and hot air. As a boiler and pipe covering it is claimed to give excellent results.

Boiler covering also forms the feature of the exhibit of the Mica Boiler Covering Company, of Toronto. This covering is manufactured in two classes, one for boiler and cylinder covering and the other for steam and hot and cold water pipes.

Several pyramids of oak-tanned leather belting are shown by the J. C. McLaren Belting Company, of Montreal and Toronto. This firm have been making leather belts for forty-seven years, and manufacture only high grade English oak-tanned stock. Their little booklet "What Makes the Wheels Go" contains much information regarding the use and operation of belts in general.

D. K. McLaren, of Montreal and Toronto, show English oak-tanned leather belting, balata and rubber belting, as well as card cloth, cotton mills supplies and belt hooks.

The Dominion Belting Company, Hamilton, have been in business but a short time, but their display indicates that they are strong competitors for the belting trade. They show the "Maple Leaf" brand of stitched cotton duck belting, also "Maple Leaf" belt dressing, claimed to add materially to the life and efficiency of a belt.

R. H. Buchanan & Company, 692 Craig street, Montreal, are agents in Canada for the Rider-Ericsson hot air pumping engine, of which two sizes, 6 and 8 inch, are shown. This engine is used largely for pumping water.

Bradley, Levy & Weston, of Toronto, have on exhibit an automatic smoke preventer which is attracting considerable attention, also a nice line of "Crown" valves manufactured by the Stouffville Brass and Steel Works, of Stouffville, Ont. This valve is said to embody features of construction different from others on the market.

The Turner Brass Works, Chicago, are represented by A.C. Anderson, 8½ King street east, Toronto, who is in charge of their display of gasoline blow pipes, carborator valves, porcelain furnaces, etc.

The Draper Manufacturing Company, of Port Huron, Mich., show valve-facing tools, ball check valves and the McGrath pneumatic flue welder.

Visitors have inspected the exhibit of the Henderson Roller Bearing Company, of Toronto, with much interest. A machine, which is particularly heavy, is driven by a ¼ horse power motor, and it is only just to the company to state that it is a very convincing demonstration of the efficiency of the Henderson bearing. The Chapman Double Ball Bearing Company also have a splendid exhibit. Much of the power provided in the building is distributed through shafting fitted with the Chapman double ball bearing. Canadian Bearings, Limited, is a competitor in the same field. A trolley wheel is shown which has been in operation the past week at a speed of 1,000,000 revolutions every ten hours, and no heat is discernible.

The large Goldie & McCulloch engine operating the shafting on the north side of the hall is driven by a 20 inch 3-ply belt manufactured by Sadler & Haworth, of Montreal and Toronto.

ENTERING THE CANADIAN FIELD.

Messrs. Read & Kilmer, 39 James street south, Hamilton, have been appointed Canadian representatives of the Fuller Wenstrom Electrical Manufacturing Company, of London, England. The latter company is the English branch of the Swedish General Electric Company, a large concern with factories at Christiana, Stockholm, Gottenburg, Vestras, Helingsfor and London. They manufacture a complete line of single and polyphase generators and single and polyphase induction motors, wound for any voltage, speed or frequency.

Mr. C. E. Kilmer, of the firm of Reid & Kilmer, spent the greater part of last winter in London making arrangements for the representation of the Fuller Wenstrom Company and inspecting the apparatus, which he found exceedingly satisfactory both as to mechanical and electrical details. On account of being able to take advantage of the preferential duty, the firm expect to obtain a considerable share of the Canadian trade. They have already received an order from the Hamilton Steel & Iron Company for a 850 h.p. induction motor and a number of smaller motors for operating the rolling mills, these to be delivered by December 1st next. This, it is claimed, will be the first instance on the American continent where rolling mills have been driven electrically. The large motor will be wound for three different speeds, namely, 275, 250 and 200 revolutions. On the rotor there are three different sets of windings that may be thrown in to give the different speeds, and the power factor will be 90 at any one of these speeds. Lower speeds down to zero will be obtained by cutting an external resistance into the rotor circuit.

The directors of the Valley Telephone Company have decided to extend the metallic line next year from Middleton to Bridgetown, N.S., and to lay a new cable across the Annapolis river at the Ferry.

The Bell Telephone Company have been given a five years' franchise by the city of Kingston, Ont. The company will put in an underground system in the business section and expend a considerable sum on new plant.

QUESTIONS AND ANSWERS

J. W. Smith : I have a 125-volt direct current dynamo which I want to equip with a pair of collector rings, so as to get some alternating current. Can you tell me what the voltage will be, and also the frequency ?

Ans.—If you put on only a pair of collector rings you will get a single phase, the voltage of which will theoretically be .707 of the direct current pressure. That is, you will get about 88 volts between your two rings, though the design of the particular machine in question may make this either a little higher or lower. We cannot tell you the frequency, as this depends on the speed and number of poles ; it can be found by dividing the product of the number of poles and the speed in revolutions per minute by 120, the result being in cycles per second.

"Enquirer" : In charging storage batteries I have been told to be careful that the charging current is not too strong. What harm will it do if it is, and is it possible to have it too small ?

Ans.—The principal difficulty from the use of too high a charging current is that it is apt to cause buckling and consequent destruction of the plates. This buckling is the result of unequal expansion and contraction of the paste in the plate, an inevitable result of too great a current density, either in charging or discharging. Another result of charging at too high a rate is that the process is then less efficient, as is evidenced by the increase in both the heating and the amount of gas given off. On the other hand, if the charging current is too small it results in the production of a film of white sulphate on the positive plate, instead of peroxide, which if allowed to grow will very soon stop any action whatever.

"W.H.," Montreal : Would you be kind enough to explain the principle of the Brotherhood engine, and how it gets its name ?

Ans.—We do not know that the Brotherhood engine has any special principle used in it which is not found in any other steam engine, though the arrangement of the various parts is decidedly novel. In the first place the three cylinders are placed 120 degrees apart, something after the method used in pulp grinders, the whole three acting onto but one crank pin. It is single acting, steam being used on one side only of the piston. Its admission is controlled by a throttling governor valve, three piston valves distributing it to the various cylinders. It is exhausted through ports which are uncovered by the pistons as they reach the end of the stroke. These latter are of the trunk form, that is, they form the crosshead as well as the piston, and thus the connecting rod and the piston rod are merged into one. The engine gets its name from Mr. John Brotherhood, who introduced it about 1873, it being one of the first high speed engines brought out for direct connection to dynamos.

"S. M." : Is there any difference between the terms inductance and reactance, or do they mean the same thing, also what is impedance ?

Ans.—The impedance is the term in alternating current work which corresponds to resistance in direct current. It is composed of two factors, one consuming energy, being the resistance of the circuit the same as if it were carrying direct currents, and the other consuming voltage, but being wattless, and called the reactance. Again reactance is divided into negative and positive. Positive reactance is due to electro magnetism and is known most commonly as self inductance or inductance. Negative reactance is due to capacity and is usually known as condensance.

"Station Man" : What is the object of the brass horns on some forms of lightning arresters ; does it matter how they are connected into the circuit ?

Ans.—The horns are put there to form an air gap of gradually increasing width, which, while narrow enough at the lowest point to let the discharge jump across, is wide enough at the top to stop the dynamo pressure from holding the arc. They are always put in with the wide part of the horns to the top so that as the hot vapor which composes the arc rises it will have a wider and wider gap to span. There is a right and a wrong way to connect them in,it being necessary to see that the blown out coil tends to send the arc upwards, if it goes the other way it will be sure to cause trouble. There are usually marks or tags on the various terminals showing how they should be wired.

"Practical" : Can I operate a 9½ ampere arc dynamo, which has been running open arc lamps, on a circuit of 6.6 ampere enclosed lamp ?

Ans.—It is very doubtful if you can do this. In the first place the machine may not be stable, that is, it may not keep up its voltage if the current be reduced to this point. Again, even if it would the armature voltage will be considerably reduced owing to the weak field. You might possibly get better results by winding more turns onto the field, or by separately exciting it from some small machine. In any case you will not likely be able to operate the regulator, nor even if you got the same voltage from the armature, would you be able to operate the same number of lamps, as the enclosed type take 80 volts each as against 50 for the open style.

"Student" : What are the equalizing rings on an armature, and what are they for ?

Ans.—These are a set of rings, varying in number depending on the size of the machine and the number of the poles, mounted usually on the back end of direct current armatures with multiple windings, and connected to the proper points therein. Their function is to equalize the voltage generated in the different sections of the armature so as to prevent local currents flowing through the brushes and commutator and thus causing bad heating and sparking. They operate by carrying alternating currents back and forth between the high and low sections, if any such should exist, these currents tending to magnetize the weak poles and to demagnetize those which are stronger. They are especially useful if the armature gets out of place in the field, due to wear in the bearings or any movement of the machine.

Tenders have just been invited for lighting the streets of the town of Durham, Ont., by arc or incandescent lights.

THE METRIC AND THE ENGLISH SYSTEM.

By James Asher.

Shall we adopt the metric system of weights and measures? The vast commerce between countries in which the English language is used and those in which it is not used seems to demand that only one system be adopted for the sake of uniformity and simplicity. A host of clerks are employed in translating weight and measures of articles which are imported and exported.

The metric system is used in nearly all European countries, South America and Mexico. The advocates of the metric system claim that it is simple and easily learned. The metre when constructed was declared to be the ten millionth part of the distance from the equator to the north pole, measured on the meridian of Paris. The metre is subdivided into tenths, hundredths and thousandths, called decimetres, centimetres and millimetres. Also ten metres are called a dekametre, ten dekametres are called a hectometre, and ten hectometres are called kilometre. The kilometre is used for measuring long distances as on roads and railways. A common man can walk 5 kilometres in an hour.

The measures of capacity are derived from the unit of length, thus: One cubic decimetre is called a litre, ten litres are called a hectolitre, and ten hectolitres are called a kilolitre. The tenth part of a litre is called a decilitre, the hundredth part of a litre is called a centilitre, and the thousandth part of a litre is called a millilitre. A cubic metre is called a stere.

The weights are connected with the measures, thus: A cubic centimetre of distilled water at its temperature of maximum density, 4°C or 39.2°F, and when the barometer is at 760 millimetres, is said to weigh a gram. Ten grams equal a dekagram, ten dekagrams equal a hectogram, and ten hectograms equal a kilogram. A man of average weight may tip the beam at 68 kilograms. The tenth of a gram is called a decigram, the tenth of a decigram is called a centigram, while the tenth of a centigram is called a milligram. A cubic metre of water is said to weigh a tonne. This is used in measuring very great weights, and is a little more than the English ton.

One very great advantage claimed for the metric system is that reduction from either a higher to a lower, or from a lower to a higher denomination is performed by merely shifting the decimal point.

Mr Gladstone said that the metric system would cause a greater saving of labor than the steam-engine. Sir William Thomson, now Lord Kelvin, is an ardent advocate of the metric system. He calls the English system a wickedly brain destroying system. He never uses the English mile if he can prevent it. He would use the knot, or nautical, or sailors' mile of 6070 feet, if obliged to use miles.

On the other hand Sir Edmund Beckett, now Lord Grimthorpe, in a fierce onslaught on the metric system? says that the metre is not what it pretends to be, for it is not exactly the ten millionth part of the distance from the equator to the north pole, measured on the meridian of Paris; that it was invented by a nation whose language is declining over all the world, and that the English language, with that standard of measures which every man carries in his arms and his legs, is spreading over all the world and will soon be the only universal language. Absurd doctrinaires may cram penny-school girls with French metres, and centimetres, and kilograms, but our yard grew and will remain as the natural standard of length until the stature of the human race alters. For it is the length of a good stride of a man of what is generally considered the best height, and that height is two such lengths, and so is the stretch of his arms, and a yard is the natural length of his walking stick. The metre would be the walking stick of a nation of giants. With the yard goes the equally natural and still older measure of a foot. See, Clocks, Watches and Bells, 6th edition, page 38.

Sir John Herschel said that the choice of the quadrantal arc of the earth's meridian, in the metric system, was a sin against geometrical simplicity, and that the polar axis of the earth, that is, the distance through the earth, which is a straight line, from the north to the south pole, should have been chosen instead.

Were the metric system at once adopted in countries where the English language prevails all the countless millions of weights and measures would become useless. The greatest confusion would prevail for a long time. In making repairs for old machines, and in the renewal of portions of buildings even, great inconvenience would be felt because the yard and the metre are what mathematicians call incommensurables, that is, there is no common measure of the metre and the yard. A man fifty years hence might need a new pane of glass for an old window. He would require the exact size of what is now called a pane 8 inches by 10 inches. Panes of that size would almost certainly not be manufactured fifty years hence. Yet the new pane would have to fit exactly. The man would ask for a pane 20.31 centimetres broad, and 25.39 centimetres long. The hardware clerk would then get a diamond and cut a larger pane.

The roads in the British Empire and in the United States are placed at certain distances apart, either a mile or some convenient multiple or some fraction of the same, for example ½ mile, ¾ mile, 1 mile, 1¼ mile, 1½ or 2 miles. Now these distances are practically fixed for countless thousands of years. Let us suppose that a man inquiring his way in the year 3000 is told by the small boy that it is 1.609315 kilometres to the next road—a distance which we now call a mile.

Farms in the British Empire and in the United States frequently contain 100 acres. In the metric system the unit for measuring land is the hectare. One hundred acres are equal to 40.467101 hectares. Now the sizes of the farms are practically fixed, for there are a certain number of farms from one road to the next road, and we have seen that the positions of the roads are now fixed. Having been laid down according to the English system they can be expressed in the metric system only by awkward whole numbers and decimals.

Suppose that a farmer in the year 3000 makes his will thus:

"In the name of God, amen:

I, John Doe, being of sound mind and body, do hereby declare that this is my last will and testament. I do hereby give and bequeath one moiety of the farm now unto me belonging, said farm being a parcel of land containing 40.467101 hectares, said moiety consisting of 20 23355 hectares; the other moiety I do hereby give and bequeath in equal shares, that is to say, I give and bequeath to my two remaining sons, James and his brother Zebedee, share and share alike, or I give, present, and bequeath unto them and to their heirs for ever, to each 10.116775 hectares of the said farm now unto me belonging."

The English system can be simplified by discarding a number of unnecessary weights and measures. The pint, the quart, the gallon and the bushel in the United States are smaller than the pint, the quart, the gallon and the bushel used in the British Empire. To make matters worse the pint and the quart of dry measure in the United States are different from the pint and the quart used in the same land in measuring liquids. What is the use of having the long ton of 2240 pounds in addition to the common or short ton of 2000 pounds? What is the use of having a hunured weight of 112 pounds in addition to the common hundred weight of 100 pounds? What is the use of having troy and apothecaries weight in addition to avoirdupois weight? What is the use of having the statute mile of 5280 feet in addition to the knot or nautical or sailors' mile of 6070 feet? What is the use of measuring the depth of the sea in fathoms of two yards each, instead of measuring it simply in yards? Why should a man measure the height of horses in hands of 4 inches each instead of simply measuring in inches? Of what use is the rod—5½ yards? This 5½ is troublesome to school children. What is the use of weighing people by the stone of 14 pounds in Britain? Not only do they there have the unnecessary stone in weighing human beings but they have a different stone of 8 pounds for weighing butchers' meat and fish. What is the use of two different hogsheads—the hogshead of beer containing 54 gallons, and the hogshead of wine containing 63 gallons?

The abbreviations for some of these units should be changed, for example dwt stands for penny weight, oz stands for ounce, lb stands for pound, cwt stands for hundred weight and £ stands for pounds in money. The abbreviations are from French and Latin words, for example dwt stands for denarius weight. Denarius is the Latin for penny. Smooth the path of the young by abolishing foreign abbreviations, and abolish useless weights and measures.

INTERESTING SUIT AFFECTING ELECTRIC COMPANIES.

The arbitrators in the case of the Consumers' Electric Company vs. the Ottawa Electric Company handed down their decision on August 10th, which was in favor of the plaintiffs. At the time the city council granted the Consumers' Company permission to do business in the city it was stipulated with the agreement of the Ottawa Electric Company that the Consumers' Company should be allowed to string wires on the rival company's poles on certain streets. The Ottawa Electric Company, however, afterwards refused this permission on the ground that the stringing of the Consumers' wires on its poles would impair the efficiency of its service. The Consumers' Company brought action against the Ottawa Electric Company in the high court. After hearing the argument of counsel, Sir William Meredith, the presiding judge, decided that the question at issue was one in which the scientific aspect overshadowed the legal bearing and he accordingly decided to refer the matter to arbitration. Three members were appointed, one by the court and one by each of the companies. The members were James B. Cahoon, of New York, appointed by the court, R. S. Kelsch, of Montreal, appointed by the Consumers' Company, and H.D. Bayne, of Montreal, appointed by the Ottawa Electric Company.

The finding determines the right of the Consumers' to string wires on the poles of the Ottawa Electric on payment of a rental of $1 per pole yearly. This applies, amongst other streets, to Rideau, Elgin, Metcalfe, Lisgar and Cooper. The Ottawa Electric is assured a corresponding use of the Consumers' poles. The cost of the arbitration proceedings is equally taxed upon both parties, while the cost of the legal action which preceded and resulted in the arbitration, must be wholly borne by the Ottawa Electric Company, defendants in that action.

When the Ottawa Electric Company, which consists of the several companies doing lighting and power business in the City of Ottawa at one time, was allowed to consolidate under one management and form The Ottawa Electric Company, the consolidation was allowed by the City Council, who passed a by-law authorizing the consolidation under certain conditions. The principal clauses in this by-law read as follows:—

1. "That the Companies will permit and allow the Corporation or any person or persons, Company or Companies, authorized by the Council and the Corporation, to use the poles of the Companies for electric purposes, on paying to the Companies such compensation for such privileges as in the event of the parties being unable to agree, shall be determined by arbitration, as hereinafter in this section mentioned, provided, however, that such privilege shall not interfere with the efficiency, operation and completion of the system of the Companies, and provided further that the privilege by this clause conferred shall not be extended to any Company which shall receive a like privilege to the Companies."

The word companies used in this paragraph refers to the several companies which form the Ottawa Electric Company.

2. "Said compensation shall be such as may be agreed upon by the Companies and the said Corporation or such other person or persons, Company or Companies, so authorized to obtain such privileges as aforesaid as the case may be, and in the event of their being unable to agree, such compensation shall be referred to the determination and award of two arbitrators, one chosen by each of the said parties to such dispute."

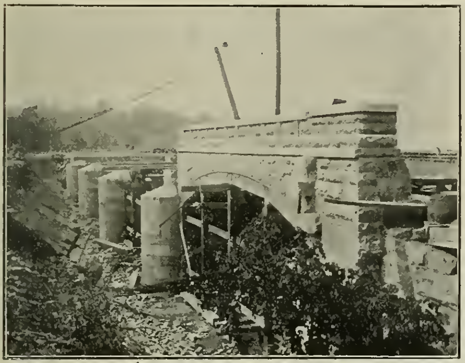
We understand that the arbitrators were unanimous on four of the six points in dispute, the Ottawa Company's arbitrator dissenting, he being unable to agree with the other arbitrators on two points, being the question of costs of the suit and the question of sufficient pole space for the Consumers Company on all of the poles.

The Grand Trunk Railway have recently installed a new system of telephone and telegraph. The system is a composite circuit telephone and telegraph, operated on one wire circuit, and is so arranged that one instrument does not interfere with the workings of the other. At present this new device is in operation between Montreal and Brockville, instruments having been placed in the despatcher's office, at Montreal, Vaudreuil, Cornwall and Brockville stations. This system doubles the usefulness of the wires wherever installed, and enables the divisional officers to communicate with those along the line by voice, and materially expedites the handling of matters pertaining to train movements. Whilst it is in the nature of an experiment, the results thus far justify the belief that the system will be universally adopted throughout the different districts of the Grand Trunk System.

BRIDGE FOR THE CANADIAN NIAGARA POWER COMPANY.

By Orrin E. Dunlap.

A bridge that is being built by the Queenston Quarry Company for the Canadian Niagara Power Company has several interesting features. The site of the bridge is in Queen Victoria Niagara Falls Free Park, and it is to span the canal inlet leading to the forebay in front of the power station of the Canadian Niagara Power Company. When completed it will be one of the links in a beautiful driveway along the upper Niagara River on the Canadian side, a locality that is just at present undergoing numerous changes as a result of the extensive power development now taking place there. These changes call for many new features, and this bridge is one of them.



New Bridge for Canadian Niagara Power Company.

The bridge is to be a concrete-steel structure with stone facing, and in general appearance will resemble somewhat the new bridge erected some months ago between the mainland and Goat Island on the New York side of the river. The length of the bridge to end of posts will be 298 feet. There will be five spans, each of 50 feet, and they will have rises of five feet. The piers will be eight feet wide on the face of the bridge and 66 feet 3¾ inches long to outside of cut-waters. The piers are set on bedrock, necessitating four or five feet of excavation. The stone used in the bridge is from Queenston, Ont. The piers below the springing line are pointed. The belts, washes and the coping are all of fine dressed work. Steel ribs spaced three-foot centers will be imbedded in the concrete of the arches. Portland cement is being used exclusively on the work.

The width of the bridge is to be 55 feet over copings, except at the piers, where there is a projection of about a foot, making the width of the bridge at the widest part about 57 feet. Inside of the copings the width is 52 feet, and of this 26 feet is to be devoted to double tracks of the Niagara Falls Park & River Railway, an electric line that skirts the river on the Canadian side, 20 feet to the driveway, and six feet on one side to a granolithic walk. The roadway is likely to be of porous gravel or cinders finished with macadam. The grade of the roadway will be practically level, the gutters being graded from the center of each arch to the piers, catch-basins being placed over each pier. Drainage is provided to be carried off in cast iron pipes that will discharge at about the springing line of the arch. It may be pointed out that the arches were made of such small rise in order to avoid raising the railway tracks, which will be on a fill approaching the bridge. The abutments of the structure are built of concrete in which large stones are imbedded. A conduit having four compartments has been built in the sidewalk for carrying electric wires for lighting the bridge, a pipe being inserted in each of the main posts. The specifications call for a loading of 5,000 lbs. per lineal foot on one track of the railway, and 100 lbs. per square foot on the driveway.

The arches and backing of the spandrel walls and the piers above springing line, are to be built of Portland cement concrete, the proportions of which are to be one part cement, two parts sand and four parts broken stone. In the piers below the springing line the proportions of the concrete are to be one part cement, three parts sand and six parts broken stone. In the construction of the bridge the contractor is required to trowel two inches of mortar onto the lagging in order to give a smooth surface on the concrete of the soffit of the arch. In building, the contractor is required to start the concrete simultaneously from the ends of the arch and lay it in longitudinal sections. While being built, timber forms hold the sections in place. The tops of the arches and backs of the spandrel walls are to be given two coats of pure Portland cement grout applied with brushes and then covered with two thicknesses of felt. This is in order that the arches may be made waterproof so that the dampness will not come through and stain the masonry.

Before the construction of the bridge a coffer-dam was built between the site and the waters of the river. The water that will pass beneath the bridge will flow to the turbines in the wheel-pit of the Canadian Niagara Power Company. High water will be 1.37 ft. above the springing line of the arch, which will be a depth of 17 9-10 ft. of water in the inlet canal. Low water will be 3.93 ft. below the springing line of the arch, or a depth of 12 6-10 ft. of water in the canal, while the mean stage of water will be 1.83 ft. below the springing line, or a depth of 14 7-10 ft. in the canal.

This beautiful bridge was designed by William A. Brackenridge, one of the consulting engineers of the Canadian Niagara Power Company, and the structure is being built under the direction of Cecil B. Smith, resident engineer of the Canadian Niagara Power Company. It is without doubt to be one of the most beautiful bridges on the Canadian side at Niagara, and will be a material factor in adding to the new beauty of Victoria Park. Its magnificent lines and fine appearance will go well toward showing that even though industry has invaded the Canadian pleasure ground at Niagara, it is the intention of the park commissioners, and also of the Canadian Niagara Power Company, so far as it is concerned, to do nothing that will mar the natural beauty of the surroundings of the falls.

New Bridge for Canadian Niagara Power Company.

MUNICIPAL STEAM TURBINE PLANT.

An interesting municipal electric lighting plant enterprise is under way at Anderson, Indiana, and marks the second introduction of the steam turbine in American municipal power plant service. The City of Anderson has for some years operated an electric light plant in connection with the city water works, located near White River. The electric installation is housed in a separate building approximately 50 x 100 feet, adjacent to the water works plant whose boilers furnish the steam power necessary for the operation of the electric light plant.

The present lighting equipment comprises two belted generating units, but the increasing demand for light and power renders the available capacity inadequate to carry even the present load at times, resulting in a severe overloading of the entire equipment. In order to secure immediate relief from these conditions and avoid the necessity of erecting additions to the power house, Westinghouse steam turbine generating units have been selected for power extensions. At the present time two 400-K.W. units will be installed, together with one 20 K.W. exciter, direct connected to a Westinghouse standard engine, and a complete switchboard equipment.

As the result of the employment of turbines in this plant it has been found possible to install a complete boiler plant in the electric light building, thus rendering the operation of the lighting system entirely independent of the water works system. The new boiler plant consists of three 310 h.p. Sterling water-tube boilers equipped with Roney mechanical stokers. The boilers will not be arranged for superheat, but will supply saturated steam to the turbines at 150 lbs. pressure, all condensation being returned to the boilers by a steam loop and Holly gravity return system. The turbo-generators will furnish three-phase current to the lighting, power and distributing system at a frequency of 7200 alternations and at 2200 volts pressure, no step-down transformers being used. The turbine equipment will operate condensing, as the plant is located near the river bank where condensing water is available. Surface condensers will be used and the condensation from the turbines will be returned directly to the boilers, as the exhaust is entirely free from oil.

An interesting feature of the turbine installation is brought out by the fact that by replacing the belted units with turbine driven units, sufficient space is made available for the installation of the complete boiler plant, together with an additional turbine unit and the necessary boilers at such times as the future demands upon the plant require this extension.

A movement is on foot to build an electric railway from Guelph to Orangeville, Ont.

The gas engine exhibit at the Louisiana Purchase Exposition will doubtless be one of the most important features of the power display, for it will not only contain many types of engines, but also several of unusual size, including one of 3,000-horse-power, which will be the largest ever built. Mr. Thomas M. Moore, chief of the department of machinery, states that there will be several such engines of over 1,000 horse-power and a few of more than 1,750 horse-power. The largest gas engines hitherto exhibited were those at Paris and Dusseldorf, which were rated at 600 horse-power. While this class of engines will be so fully represented, the equally interesting type of steam turbines will probably be just as thoroughly covered; in fact, the largest prime mover at the Exposition will be an 8,000 horse-power Curtis turbine.

THE BURSTING OF EMERY WHEELS.

Several years ago the writer was consulted regarding some points of a case in litigation occasioned by the bursting of an emery wheel and the resulting death of a workman. The question to be decided was whether the wheel was unsafe at the speed recommended by the makers, or whether the accident was due to the carelessness of the operator.

As it was just then an "off" year for experiments on fly-wheels there seemed to be no good reason why the same medicine could not be tried on emery wheels. The apparatus already described in former papers read before this Society, with some slight alterations, was adapted to the new requirements, and in the spring of 1902, fifteen wheels of various makes were tested to destruction.

TABLE.

No. of Test.	Grade Mark.	No. of Emery.	Working Speed. Revs. per Minute.	Working Speed. Feet per Minute.	Bursting Speed. Revs. per Minute	Bursting Speed. Feet per Minute.	Speed Ratio.	Factor of Safety
1	4.5	20	1,200	5,030	3,100	13,000	2.58	6.67
2	.5	20	1,200	5,030	3,200	13,400	2.67	7.14
3	4.5	20	1,200	5,030	3,350	14,020	2.79	7.73
4	Q	30	1,250	5,230	3,750	15,700	3.00	6.00
5	Q	30	1,250	5,230	2,750	11,500	220	4.84
6	H	30	1,400	5,870	4,550	19,050	3.25	10.56
7	H	30	1,400	5,870	4,600	19,200	3.28	10.76
8	O	36	1,250	5,230	4,100	17, 00	3.28	10.76
9	O	36	1,250	5,230	4,125	17,250	3.30	10.89
10	2.5	60	1,150	4,830	2,700	11,500	2.39	5.71
11	2.5	60	1,150	4,830	2,900	12,100	2.52	6.35
12	M.H.	14	1,200	5,030	3,100	12,970	2.58	6.66
13		24	1,200	5,030	3,800	15,900	3. 7	10.00
14	H	10–12	1,200	5,030	4,100	17,200	3.42	11.70
15	H	10–12	1,200	5,030	4,350	18,200	3.62	13.10

Tests 6 and 7; wheels made with wire netting; tests 14 and 15, with vulcanized rubber.

For the actual details of the work credit is due to Messrs. Chandler and Krueger of the class of 1902, Case School of Applied Science. Most manufacturers of this class of wheels test them for their own information, but the results are not generally given to the public; the writer knows of no published data on this subject. At the Norton Emery Wheel Works, all wheels are tested before leaving the shop at a speed double that allowed in regular service, and occasionally wheels are burst to determine the actual factor of safety.

Emery-wheel accidents are not uncommon, but can usually be traced to the carelessness of the operator. One common cause of failure is allowing a small piece of work to slip or roll between the wheel and the rest. The writer was once present on an occasion of this kind, and although he fortunately was not in the plane of rotation, he has never forgotten his sensations

The wheels selected for the experiments were all of the same size, being sixteen inches in diameter by one inch thick, and having a hole one and one-quarter inches in diameter.

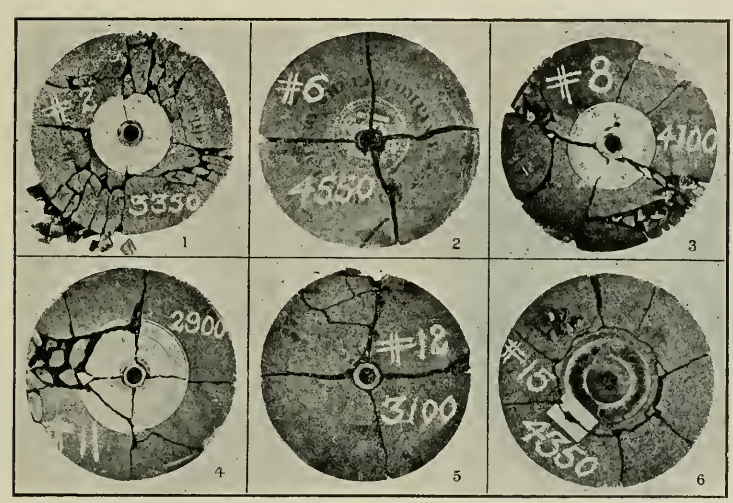
---

*Papar read before Saratoga Convention of A. S. M. E., by Prof. C. H. Benjamin.

The object of the experiment being to determine the bursting speed of such wheels as are actually on the market, emery wheels were obtained through various outside parties without indicating to the agents or manufacturers the use to be made of them.

In this way wheels of six different makes were obtained, the label on each wheel showing usually the maker's name, the grade number or letter, the quality of emery, and the speed recommended for use. As shown in the table of results, the working speed varied in the different wheels from 1,150 to 1,400 revolutions per minute, the average being about 1,200 revolutions per minute. For a diameter of sixteen inches this corresponds to a peripheral velocity of about 5,000 feet per minute. The table also shows that the fineness of the emery varied from ten to sixty, the average being about thirty.

The wheels were held between two collars, each six and one-eighth inches in diameter and concaved, so as to bear only on a ring three-fourths of an inch wide at the outer circumference.



Results of Experiments on Emery Wheels.

The method of testing, and the apparatus used, were precisely similar to those described in the paper on "The Bursting of Small Cast-iron Flywheels," by the author at a previous meeting, to which reference is made for illustrations of the apparatus.

The table shows the results of the experiments in detail, and needs but little explanation. The illustrations, Figs. 1 to 6, show characteristic fractures, and the appearance of various wheels after bursting.

Wheels numbered 1, 2, and 3 were of one make, and show a remarkable uniformity in strength. (Fig. 1.)

Nos. 4, 5, 8, and 9 were all made by one firm; the two latter wheels were of finer grain than the others, and show a correspondingly greater strength. (Fig. 3.)

Nos. 6 and 7 contained a layer of brass wire netting imbedded in the emery, and were about one-third stronger than the average of the ordinary wheels. (Fig. 2.)

The wheels numbered 10 and 11 were the weakest among those tested, but have an apparent factor of safety of between five and six. (Fig. 4.)

Nos. 12 and 13, of still another make, burst at about the average speed. (Fig. 5.) Wheels Nos. 14 and 15 were so-called vulcanized wheels, containing rubber in the bond, and intended for particularly severe service. These showed, as was expected, rather more than the average strength. (Fig. 6.)

An examination of the last two columns in the table shows that the wheels burst at speeds varying from two and one-quarter to three and three-quarters the working speed, and accordingly had factors of safety varying from five to thirteen.

It is then apparent that any of these wheels were safe at the speed recommended, and would not have burst under ordinary conditions. At the same time, considering the violent nature of the service and the shocks to which they are exposed, it would seem that the factor of safety for emery wheels should be large. In comparison with those generally used in machines, a factor of eight or ten would seem small enough.

It may also be said that such a variation in strength between wheels of the same make and grade, as for instance that between Nos. 4 and 5, indicates a lack of uniformity which causes distrust.

The fractures were in the main radial, as may be seen from the cuts, the wheel splitting in three, four or five sectors as might chance.

It may be assumed that these radial cracks started from the rim where the velocity and stress were greatest, but it is a fact worthy of notice that in nearly every instance the cracks radiated from points where the lead bushing projected into the body of the wheel.

The citizens of Whitby, Ont., have declared themselves in favor of taking over and extending the existing electric light plant.

The town of Lucknow, Ont., will likely purchase the electric light plant from the owners and install a modern system. Mr. H. F. Strickland, electrical engineer, of Toronto, has the matter in hand for the town.

The Thos. E. Clark Wireless Telegraph-Telephone Co., of Detroit, Mich., announce that they are erecting stations at Pontiac, Mich., on the State Fair Grounds, for the purpose of carrying on commercial telegraphing.

ENGINEERING and MECHANICS

ANNUAL CONVENTION OF STATIONARY ENGINEERS.

The fourteenth annual convention of the Canadian Association of Stationary Engineers took place at Berlin, Ont., August 25th and 26th. The headquarters of the delegates was the Walper House, the proprietor of which is Mr. George Philip, a brother of Mr. E. J. Philip, of Toronto, an old member of the C.A.S.E. The business sessions were held in the council chamber. Those present included the following:

W. Oelschlager, Berlin, president; H. E. Terry, Toronto, vice-president; W. Inglis, Toronto, secretary; J. Ironsides, Hamilton, treasurer; N. Beam, Waterloo, doorkeeper; J. Struthers, Sarnia, conductor; N. V. Kuhlman, A. M. Wickens, G. C. Mooring, J. Huggett and J. M. Dixon, Toronto; W. F. Crockett and S. Sculthorpe, Hamilton; J. R. Uttley, Waterloo; T. King, Dresden; J. H. Walker, Berlin; J. Ogle, Brantford; A. M. Turkington, Brockville; D. McEvoy, Toronto, representing the Fairbanks Company.

PRESIDENT'S ADDRESS.

In his presidential address W. Oelschlager pointed out the importance of the convention, which would probably determine whether the Association would be carried on or would cease to exist. He urged the continuance of the work and the broadening of its field, and suggested that efforts be made to re-organize defunct local associations. He suggested the continuance of the lesson papers and to make them progressive, that is, lead them up gradually from the primary to the mathematical problems required to be answered by certificate examinations, also that the engineers in their respective localities ask their employers to give financial aid to the individual lodges. He expressed the belief that if the Executive of the C. A. S. E. were kept afloat public interest would revive and the association flourish to a greater extent than ever before. In conclusion he respectfully suggested the following:

Mr. H. E. Terry, Toronto,
President Canadian Association of Stationary Engineers.

1. That our preamble be re-inserted in charter and constitution.
2. That a sum of money be voted towards the expenses of visiting defunct lodges with the object of re-organizing the same.
3. That the educational leaflets be pushed more vigorously, and a charge covering printing expenses be made.
4. That our employers be informed that we are hereby asking a cash contribution of them.

The address was referred to the Committee on Good of the Order and the following standing committees were appointed:

Good of the Order—J. M. Dixon, J. Ogle, J. Walker, J. Ironside, H. E. Terry, A. M. Turkington.

Mileage—N. Beam, F. Sculthorpe.

Audit—N. V. Kuhlman, F. Sculthorpe.

Ways and Means—N. V. Kuhlman, W. F. Crockett, G. C. Mooring, T. King, A. M. Wickens, W. Inglis.

Credentials—T. King, A. M. Turkington.

At the afternoon session the minutes of last meeting were read and adopted and the reports of the secretary and treasurer received and referred to the Audit Committee. The secretary reported that nothwithstanding the loss of one order, Sarnia No. 20, the membership stood at 258, a decrease of only four from last year. He had been in communication regarding the formation of lodges at Calgary, Brandon, and Halifax.

Much of the afternoon was devoted to a discussion regarding legislation and the position of the International Union of Steam Engineers, some of the delegates present apparently being in favor of throwing in their lot with that organization. The meeting adjourned early to enable the delegates to visit the sugar refinery at Bridgeport.

Upon resuming at 8.30 p.m. it was decided to receive and discuss the report of the committee on ways and means clause by clause. The report as adopted is as follows:

REPORT OF COMMITTEE ON WAYS AND MEANS.

Clause 1.—That we view with alarm the general tendency towards withdrawing from this Association during the previous year. We beg to recommend that twenty-five questions be formulated, and that the executive give a cash prize for the best solution of them.

Clause 2.—We also recommend that every secretary of a subordinate Association be instructed to write to every sister Association the progress that has been made in this regard, and give a synopsis of the work done in this respect.

Clause 3.—We also recommend that wherever possible, a better intercourse be initiated with each other by means of a system of fraternal visits.

Clause 4.—We also recommend that we use every legitimate effort to build up the Association, and that the sum of $10 be granted to any member who shall organize a new Association or resuscitate a defunct one.

Clause 5.—We also recommend that every Association be instructed to be as aggressive as possible, so as to build up their membership.

Clause 6.—We would also like to see a fraternal spirit shown between members of each Association, and that each individual member aid and assist those who are not so well versed as themselves in the different lines of work.

SECOND DAY.

On Wednesday morning the report of the Committee on Good of the Order was taken up. It recommended that the preamble be amended to suit the present position of the association; that a sum of money be voted to cover expenses for visiting lapsed lodges, as by a judicious expense the association would be held firmly together and members of small districts could be specially educated in the Brotherhood of the Society; the continuation of the monthly leaflets as another source of keeping in touch with lodges of a lukewarm character; that the question of soliciting cash contributions be left in the hands of the local associations.

Concerning the notice of motion that Toronto No. 1, after this session, will withdraw from the Executive of the C. A. S. E., the Committee reported as follows: We sincerely regret that such a resolution should emanate from Toronto, No. 1. It has been the parent of the Association, has fostered and expended money and effort on the development of its life, and now when our existence is seriously imperilled, such attempt at desertion of our ranks is at least reprehensible, but while we deplore this we beg to refer the members of No. 1 to that portion of the constitution on subordinate lodges, Section 2, Article 3, which states that five members in good standing can object, and according to our interpretation can hold all assets belonging to and existing under the charter. Again, in the Executive power, any subordinate lodge failing to return capita tax and other returns specified shall forfeit its charter. Under these conditions we consider it unwise for this present convention to take notice of such motion.

The recommendations of the committee were adopted excepting that portion dealing with the preamble, which was referred to a special committee consisting of Messrs. Wickens, Moseley, Dixon, King and Crockett. This committee recommended the following as the wording of the preamble: "That this Association shall not at any time be used for religious or political purposes, always recognizing the identity of interests between employer and employee, and always keeping in view the furtherance of mechanical and expert training for its members, thereby proving its close accord with their employers, believing that cultivated brain power is always in demand at fair figures of remuneration."

The recommendation of the committee was adopted. The Executive Secretary was instructed to ask Toronto No. 1 to reconsider its decision to withdraw from the Executive. The question of establishing a Question Box, similar to that of the Canadian Electrical Association, was discussed, but it was felt that the expense involved would be more than the association could stand at the present time.

At the opening of the afternoon session the secretary was requested to read the letters received regarding the possibility of forming new associations. This was followed by a discussion as to the best means of encouraging the formation of branches in the smaller places. It seemed to be generally admitted that if more earnest efforts were put forth the membership of the association could be greatly increased, and it is understood to be the intention of the president-elect to endeavor to awaken in outside places an interest in the work of the association.

The result of the election of officers was as follows: President, H. E. Terry, Toronto (acclamation); vice-president, J. Uttley; Waterloo; secretary, W. Inglis, Toronto (acclamation), treasurer, J. M. Dixon, Toronto; conductor, F. W. Sculthorpe, Hamilton; doorkeeper, J. Ogle, Brantford. It was decided to hold the next convention in Hamilton. The newly elected officers were installed by past-presidents Wickens and Moseley.

The sum of $25 was voted to the Executive Secretary, and $5 to A. M. Wickens for the preparation of instruction papers. A past president's jewel was presented to the retiring president, W. Oelschlager. Votes of thanks were tendered to the local committee, the city council and the local and mechanical press. A brief address by president-elect Terry closed the business proceedings.

THE BANQUET.

The convention concluded with a banquet at the Walper House on the evening of the 26th ultimo, at which about fifty persons were present. W. Oelschlager was the presiding officer. The menu was inscribed on a blue print in an artistic manner, the handiwork of Mr. Oelschlager. The toast of "The King" was followed by "Canada our Home," to which Dr. Lackner, M.P.P., responded. He spoke of the great natural resources of the country and the importance of the engineer in relation to their development. He was in favor of a license law for engineers. Mr. J. M. Dixon contributed a song, which was much enjoyed. To the toast of "The Manufacturers" D. McEvoy, of the Fairbanks Company, and T. King, of Dresden, responded. "Sister Associations" brought a response from W. H. Cone. He stated that 20 years ago when he started to obtain his first engineering experience, the old slide valve engine was in common use. He called attention to the waste of steam caused by running a slide valve engine, but was told by his employer that there was plenty of fuel to burn. To-day we were face to face with a different proposition, the present tendency being to save fuel. He thought that electricity had done more to develop the steam engine than anything else, and concluded by an earnest plea for efficiency in engineering and in electrical work. Messrs. Terry, Inglis, Dixon and Ogle responded to the toast of the "C.A.S.E." and Messrs. Wickens, Mooring and Moseley to that of "Past Presidents". The Presiding Officer and Local Association was then toasted and responded to by Messrs. Oelschlager and Walker. After toasts to the "Press" and the "Host" the function terminated.

The Bell Telephone Company have just commenced the erection of a four-storey building at the corner of St. Andre and St. Catharine streets, Montreal.

Negotiations are stated to be in progress for the absorption of the lines of the Great North-Western Telegraph Company of Canada by the Western Union Telegraph Company.

PRIORITY OF CLAIM FROM INDIA.

Mr. E. J. Lopaz, of the Indian Government Telegraph Department, writes: "I notice on page 67 of the May issue of the Canadian ELECTRICAL NEWS that Prof. Fred Bedall has invented, or rather discovered, a new method of 'transmitting two currents on one wire.' With reference to this, I wish him luck and every success. I beg to point out that in the summer of 1892 I invented a method—a new method—of transmitting two currents on one wire, and used it for duplex telegraphy very successfully on a long overland line 1300 miles in length."

ELECTRIC PLANT AT MEMRAMCOOK.

Messrs. Wm. J. O'Leary & Company, electrical contractors, Montreal, are installing an electric plant in St Joseph's Universitiy at Memramcook, N.B. It will consist of one 56x14 horizontal tubular boiler built by the Robb Engineering Company, of Amherst, N.S.; one 10x10 Robb-Armstrong engine; two 15 k.w. 125 volt Westinghouse d.c. belted generators; and one 3 k.w. 50 volt Westinghouse d.c. belted generators. There will be used as a booster 62 cells of E 13 chloride accumulators and there will be a switchboard of five panels.

The boiler supplies steam at 100 pounds pressure to the engine and also to an 8x8 Robb-Armstrong engine hitherto used in running the laundry. The generators may run singly or in multiple, supplying current to the busses at 125 volts. The booster raises this 50 volts, giving 175 volts between the battery charging busses.

The switchboard consists, as stated, of 5 panels of blue Vermont marble, 48x22x1¼. The first two are the generator panels with the usual instruments, switches, etc; the third a feeder panel; the fourth the booster panel, with connections throwing in the booster and regulating its voltage in charging; the fifth a storage battery panel, supplied with an end cell switch for regulating the voltage in discharging, an overload and an underload circuit breaker, double reading ammeter and voltmeter.

It is proposed to run the engine daily from 5 to 10 p.m. The generators will take care of the lighting load and at the same time charge the battery. The plant will then be shut down and the battery will carry the night and morning load until 5 a.m. the next day. The capacity of the battery is 240 ampere hours on an eight hour basis. Two days during the week the small engine will run the laundry and charge the battery if necessary. In case of a break-down to either an engine or generator or to an engine and generator together the remaining engine can charge the battery during the day and with its assistance carry the evening load without interruption.

The officials of the Montreal Street Railway Company have received copies of the agreement arrived at between the special committee and the management of the company for the organization of a mutual Benefit Association. The affairs of the association are to be managed by a committee composed of five members to be elected annually by the members of the association and an equal number by the Board of Directors of the company, and in addition the general manager of the company shall be president and ex-officio member and chairman of the said committee, five members of the Committee of Management to form a quorum. The company shall contribute to the funds of the association a sum annually not less than 50 per cent., or such larger amount not exceeding 100 per cent. of the annual contributions of the members as the directors of the company may from time to time elect.

A TIDE-MOTOR.

A solution of the old problem of how to get mechanical power from the rise and fall of the tides is attempted by Mr. T. B. Stoney, M. Inst. C. E., of Oakland Park, Raphoe, County Donegal, who has patented a tide-motor driven by large steel floats—boxes open at the top floating in a shallow dock. The float rests on the ground at low water; but the tide rising round the empty float forces it up and carries it to the top of the tide. As the float rises it raises a rack attached to the wall of the dock, and as the rack rises it turns a horizontal shaft on the dock wall. At the top of the tide the float is allowed to fill with water, which weights it to the ground again when the tide recedes. Any number of floats can be used, chained together, and thus any required power can be brought into work; but the movement is, of course, very slow. The inventor points out that in estuaries on the English coast the tidal rise is very great. In the Severn it is 46 ft. at spring tides. Floats working in shallow docks in such estuaries would work night and day at a very small working cost, and might be made to generate electricity at about one-tenth the cost of a steam engine, the electric current being distributed inland by wires.

THE PRESTON AND BERLIN ELECTRIC RAILWAY.

The electric railway from Preston to Berlin, Ont., was officially opened on August 21, although a regular service on schedule time was not commenced until August 26th. This road is in reality an extension of the Galt, Preston and Hespeler electric railway which has been in operation for some years. The distance from Preston to Berlin is about 8 miles. The fare charged for the return trip is only twenty-five cents, or about 1½ cents per mile. It is expected that a large business will be done, as it is the intention to carry freight as well as passengers. The road passes through a fine stretch of country, and as the rolling stock is very fine the tourist traffic should be quite heavy in the summer season. The cars are 53 feet in length, 9 feet wide, and about 15 feet high. They are finished outside in a dark green color, the interior being in quarter-cut oak. There are fifteen seats which provide seating capacity for nearly 100 persons.

Ultimately the power for the operation of this road will be obtained from a power house now in course of erection at Preston, where the road connects with the Galt, Preston and Hespeler Railway. Mr. John Patterson, of Hamilton, was largely instrumental in securing the building of this road.

POWER LOST BY FLYWHEELS.

A series of tests recently concluded at the Nurnberg central electricity station shows very clearly that the resistance which a flywheel offers to the air may give rise in some cases to a considerable waste expenditure of energy. The station in question is provided with two tandem compound engines of 450 horse-power, direct-coupled to the dynamos, and working at ninety-five revolutions per minute. In order to equalize the running with the great variations of load which occur, a very heavy flywheel was used with the arms of a channel section. These arms were found to offer a great resistance to the air and to create a powerful draught. It was therefore decided to cover the wheel with sheet iron in order to reduce the resistance and thus gain considerable power. In order to test the amount of energy lost, the dynamo was made to run as a motor and thus drive the engine and flywheel at no load. When the latter had no protecting covering it was found to absorb 13,300 watts, but when the covering was replaced it took only 9,874 watts, thus showing a gain of 3,426 watts, or 5.7 horse-power, this being 1.2 per cent. of the power of the engine. Counting the current price per kilowatt-hour and a day's run of seventeen hours, it was calculated that this represented an economy of nearly £56 annually. Another test of a similar nature was made upon a 630-horse-power engine, and showed an economy as high as thirty horse-power, or 4.8 per cent. of the engine power, which was gained by properly diminishing the air resistance of the flywheel. — Electrical Engineer (London).

SPARKS.

The Stave Lake Power Company, of Vancouver, B. C., are said to have disposed of their rights to the water power of Stave Lake and Stave River to Mr. Charles H. Baker, of Seattle, Wash. Mr. Baker has had preliminary surveys made and purposes developing the power and transmitting it to Vancouver, New Westminster and possibly Sumas and Seattle. The directors of the Stave Lake Power Company include Sir Thomas Shaughnessy, Sir Charles Tupper, and Messrs. R. H. Alexander, John Hendrie, Thomas Tait, and G. C. Hinton, of Vancouver.

The promoters of the Radial Electric Railway in the county of Kent have received their charter and will commence work at an early date. The first section of the road to be constructed will be from Chatham to Wallaceburg. The chief promoter of this enterprise is Mr. N. H. Stevens, of Chatham.

TO THE TRADE

WE are now in a position to fill orders promptly for Knife Switches of any size from 10 to 1000 Amperes. We have a modern up-to-date factory, using best methods, and making prompt deliveries. We solicit your trade.

The Hill Electric Switch Co., Limited, 426 St. Paul Street
MONTREAL

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

Vol. XIII. OCTOBER, 1903 No. 10.

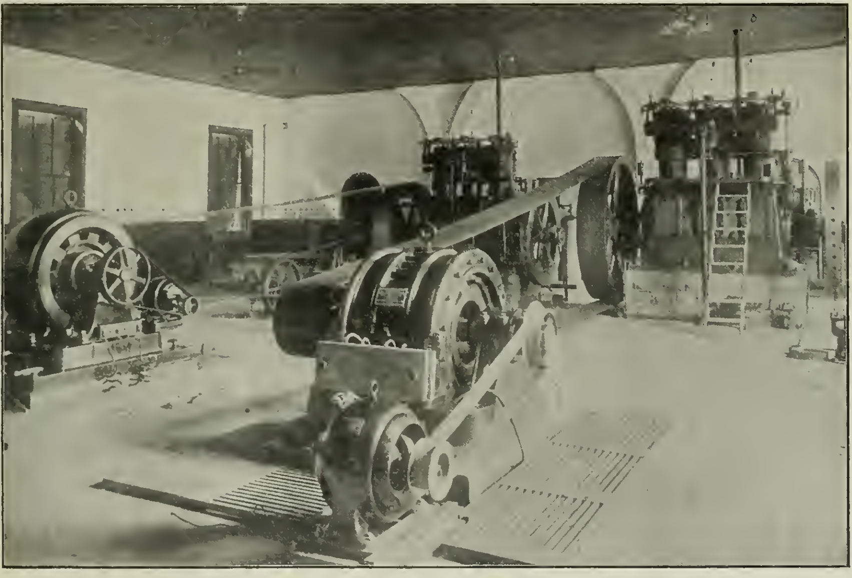
COMBINING GAS AND ELECTRICITY.

A visit by our representative to Chatham to see the new plant recently installed by the Chatham Gas Company will be of interest to our readers. Gas engines are used as motive power for the electric plant and are the first to be installed in Canada by a gas company operating an electric lighting plant and using artificial gas for engines. This company does commercial lighting only, as the city own a municipal lighting plant.

The buildings, shown on the following page, are two-storey, of pressed brick and stone, and present a fine appearance. They stand in the centre of three acres of land. The company have six thousand lights wired up in the city and business is rapidly increasing. They operate gas, arc, and incandescent lighting, the tendency being more towards electric lighting, the gas being used principally for heating and cooking, and costing one dollar per thousand feet.

The arrangement of the company's plants, from rear on river bank to King street front, is exceedingly good. Upon the river bank at the rear are the wharves and steam coal hoisting plant. Coal is freighted by water from Cleveland, Toledo and other ports, conveyed into sheds immediately at the rear of the retort house of the gas works; it is elevated to the charging floor of retort house seven feet in height by a ten h.p. gas engine, manufactured by the Coldie & McCulloch Company, of Galt.

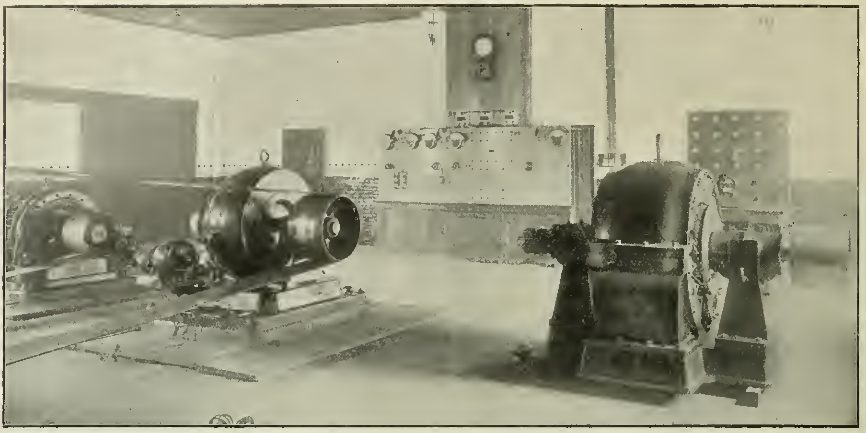
The retort house, coming next in order, contains four benches of six retorts each, with capacity for making gas of 220,000 cubic feet per day, the company's present output being 90,000 feet. The gas benches are modern type half-depth regenerative, made by the Jas. Gardiner, jr., Company, of Pittsburg, and are very satisfactory in operation. Next in order comes the condensing plant of the gas works. This room contains the latest type of condensing and scrubbing, tar and ammonia extracting apparatus, with a capacity of 300,000 cubic feet daily and recently installed by the Economical Gas Apparatus Construction Company, of Toronto. The next room contains purifiers, station meter and governor for gas works, and also a small gasholder of a capacity of 15,000 cubic feet, which is used entirely for storage for gas engines. This holder is connected and may be filled either from the retorts direct or from the larger gasholder used for supplying the public.



The Chatham Gas Company—View of Power House Looking Toward Gas Engine.

In the electric power house two Westinghouse gas engines are installed, one of 125 horse power, the other of 85 horse power, also one S.K.C. single-phase alternating generator of 80 k.w., 1000 revolutions, and one Warren single-phase alternator of 60 k.w., 800 r.p.m. The engine-room is 60 x 45 feet.

The switchboard contains four panels, with three ammeters, three voltmeters, and three ground detectors, all of the Whitney type. Westinghouse lightning arresters are also installed. Space is reserved in this building for the installation of another engine next summer. At the rear of the coal sheds is an auxiliary steam plant held in reserve, in which are installed a 150 horse power automatic high-speed engine, made by Armington & Sims, driving an 80 k.w. Royal Electric generator, and a 50 horse power high-speed engine of the same make drives a 30 k.w. dynamo.



The Chatham Gas Company—View of Power House, Looking From Gas Engine Toward Switchboard.

The gas engines are started by compressed air. The tanks are kept at a pressure of 200 lbs. and are filled by a Westinghouse air pump. The air tanks are connected to a cylinder of each engine and the cylinder acts as an air motor for starting the engine.

Both the gas and electric plants have been erected completely new within the past two years, and with a view to future extensions. The company owns extensive properties on each side of the works; both the gas engine electric plant and the retort room of the gas works are arranged for tripling the capacities of each, if necessary.

The Chatham Gas Company—Office Building.

Coal enters the rear end of the building and is transformed into electric power in one continuous operation—from the coal sheds to retort room, there transformed into gas and taken to the gas-holder, from the gas-holder to the gas engines, from the engines power is delivered to the generators, and from the generators to the public.

In conversation with the obliging manager he said the advantages of gas engines as motive power for gas companies operating electric plants were: No more coal required for gas engines than for steam for equal amount of power; the by-products of coal obtained after gas is produced, namely coke, tar and ammonical liquor, very largely reduce the cost of the coal; gas engines require no fireman—one engineer can operate a number of engines; cost of maintenance is very largely reduced; no repairs for steam pumps, condensers, furnaces, grate bars, boilers, etc., nothing but ordinary repairs to engines themselves, which would not be more than steam engines of equal power; practically no danger from fire, there being no fire of any kind in gas engine plant; engines are ready to start up at a moment's notice at any time, starting by compressed air.

The Chatham Gas Company Electric Power House and Gas Works.

The offices are on the second floor of the main building, the lower floor being used for workroom and storage of supplies.

The company has its own teams for delivering coke, selling largely to the public for furnaces, stoves, ranges, grates, etc.

They keep a large force of wiremen, contract for electric wiring both in the city and outside, sell electric supplies to neighboring towns, etc.; install gas lamps of all kinds, as well as gas ranges and heaters, etc.

The company's officers are composed as follows: William Ball, president; Manson Cambpell, vice-president; P. S. Coate, manager and secretary-treasurer.

The Electrical Development Company of Ontario—View Showing the Progress on Crib Cofferdam.

ELECTRICAL DEVELOPMENT COMPANY OF ONTARIO, LIMITED.

Of the three Canadian companies now engaged in the development of the mighty power of the Niagara, the plans upon which the work of the Electrical Development Company of Ontario, Limited, is proceeding are perhaps the boldest and most original. This company, which is composed of Toronto capitalists, secured their charter only last February, but no time was lost, and within two months the work was under way. By agreement the company will dispose of their electric energy to the Toronto and Niagara Power Company, who are constructing the necessary pole line from the Falls to Toronto. It is proposed to develop 125,000 horse power, the location being a little above that of the Canadian Niagara Power Company, in the Queen Victoria Niagara Falls Park. The rapid progress that has been made is shown by the accompanying illustrations from photographs taken by the company late in September and loaned to the Electrical News for publication.

The Electrical Development Company of Ontario—View from Rock in River, Showing Cascade and Launching of Crib.

The Electrical Development Company of Ontario—View Showing Protective Work at Mouth of Shaft of Tail-Race Tunnel.

The first cut forms a panoramic view showing the progress on the crib coffer dam. The second illustration is an exceedingly good one, showing the cascade and launching of crib, and gives a splendid idea of the magnitude of the work. In the last view is seen a good deal of detail and particularly the protective work at the mouth of the construction shaft of the tail-race tunnel.

The features of the development include a large dam, wheel-pit and tail-race tunnel. A cofferdam of crib work was built to shut off the water. Of the main dam 1276 lineal feet had been constructed by September 30th. This dam is built out into the river at an angle of perhaps 40 degrees with the shore. It is of timber cribbing, with rock filling and water-proofed clay puddling. It will average about twenty-five feet in height, perhaps 8 to 10 feet above the surface of the water.

A few weeks ago the current at one point was so heavy that the contractors had a fender constructed as a protection to the dam. This was made of the heaviest square timber, in triangular form, and was anchored at the danger point by a one-inch twisted steel wire cable. Shortly after it was placed in position the cable snapped like a silk thread, the fender was dashed down the current, and whirled into the eddy beyond the dam. To bring it back against the stream was impossible, so a new fender was built, drifted down to position and anchored by stronger cables, which are held in place by the aid of a donkey engine in constant operation.

The wheel-pit, for which Mr. M. P. Davis, of Cornwall and Ottawa, has the contract, will be 416 feet long, 160 feet deep, and 22 feet wide. Ten steel penstocks will carry the water from the intake to the turbines, and as the pressure at the bottom carried by the 160-foot fall of a ten-foot cylinder of water is over 400 tons, the penstocks, the wheels, and indeed the whole work must necessarily be of an exceptionally heavy character. The preparatory work for the excavation of the wheel-pit is now under way.

Mr. Anthony C. Douglas, who is building the tunnel of the Canadian Niagara Power Company, is also building the tunnel of the Electrical Development Company. Whereas the tunnel of the Canadian Company runs underground, that of the Electrical Development Company will run under water. In other words, it will be for its whole length 160 feet below the bed of the Niagara river, and its mouth will be in the very heart of the Horseshoe Falls. This tunnel will be 2,200 feet long from wheel-pit to discharge, 24 feet wide and 28 feet high. The preliminary shaft has already been sunk to a depth of 150 feet. From the bottom of this shaft there will be built a lateral tunnel 8x15 feet, extending out under the river bed about 650 feet to the line of the main tunnel. From this junction point headings will be driven up and down stream in the construction of the main tunnel. One disadvantage of this form of tunnel is that work cannot be begun from both ends. It may begin, however, at the intersection of the tunnel line with the construction drift at the same time as it begins at the wheel-pit. However, Contractor Douglas has executed the work with great dispatch, having made a record in the sinking of the shaft. The tunnel is being drilled by compressed air drills, and when completed it will be timbered and lined with concrete and brick, a necessary precaution when water is driving through at a rate of twenty-five feet a second.

A NOVA SCOTIAN ELECTRIC PLANT.

The new electric light plant of the town of Liverpool, N.S., consists of an hydraulic development, with earth and gravel dams, diverting the water of the main river at Liverpool through a natural swale. The water thus diverted is sufficient to develop a maximum of 1,900 h.p., under a working head of twenty-two feet.

There are two retaining dams ; one acting as a wing dam to the other. At the junction of the two dams mentioned there will be a large wooden flume connecting the water to the turbine settings, which are of the open type.

The Jenckes Machine Company have the contract for a pair of 40-inch wheels, both inclosed in one casing, developing 755 h.p., under 22 feet head of water, at 168 revolutions per minute. Provision is being made for the future installation of two similar settings.

The electrical contract has been awarded to the Canadian Bullock Electric Manufacturing Company, and will consist of two 225 K.W. A.C. 2-phase generators. Provision will also be made for the future installation of four similar machines. The contract also embraces line construction into the town of Liverpool.

This plant is under municipal control and will cost about $50,000. It is calculated to deliver light and power to Liverpool and surrounding territory.

Both the hydraulic and electric work of the plant is being engineered by the Maritime Electric Company, of Halifax, of which Mr. G. C. Siebert is manager. It is expected that this plant will be in operation this fall.

To find the load which a given pair of engines will start : Multiply the area of one cylinder by the pressure of steam and twice the length of stroke. Divide the result by the circumference of the drum, and deduct one-third (say) for friction.

FIRST ANNUAL FIELD DAY.

The office employees of the Canadian General Electric Company and the Canada Foundry Company, Toronto, held their First Annual Field Day on Saturday afternoon, October 3rd. The Toronto Lacrosse Grounds in Rosedale were engaged for the occasion. The games were well contested and held the interest of the spectators throughout. Universal satisfaction was expressed at the way the events were run off, everything going along without a hitch, owing to the very efficient handling by the Executive Committee. The prizes were distributed at the works offices of the Canada Foundry Company by the Assistant Superintendent, Mr. A. C. MacCallum, and at the head office by the Comptroller, on October 8th.

The Executive Committee having charge of the arrangements was composed of Messrs. A. Oakley (chairman), A. W. Roberts (secretary treasurer), H. G. Nicholls, E. D. McCormack, William McCaffery, Norman McLeod, E. Wedd, K. L. Aitken, and Charles Oakley.

The Field Officials were: Referee, Mr. George W. Watts; Judges of Track Events, Messrs. H. G. Nicholls and Charles Oakley; Judges of Field Events, Messrs. J. J. Ashworth and G. Boyd; Starter, Mr. A. Oakley; Scorers, Messrs. Walter Nicholls and A. R. Leicester; Clerk of the Course, Mr. R. T. Mackeen.

The winners in the different events are given below :

1. 100 yards Dash, 16 and under : (1) Norman Richards ; (2) Harold Williamson ; (3) Bert Gould.
2. Sack Race : (1) J. H. Harris ; (2) J. M. Oxley.
3. 100 yards Dash : (1) Wm. McCaffrey ; (2) Ernest Kerrigan.
4. 220 yards Race, 18 and under : (1) Harry Robertson ; (2) Frank Mulhall ; (3) W. Cartwright.
5. Bicycle Race, 1 mile : (1) H. Dennison ; (2) J. H. Harris.
6. Throwing Baseball : (1) E. Trowbridge ; (2) K. W. Tandy.
7. Hurdle Race : (1) H. Dennison ; (2) Wm. McCaffrey.
8. Putting 16 pound Shot : (1) J. Glubeland ; (2) W. Nicholls.
9. Three-Legged Race, 100 yards : (1) F. Patterson and H. Philpot ; (2) F. Regan and J. H. Harris.
10. Running High Jump : (1) Ernest Kerrigan ; (2) K. L. Aitken.
11. One Mile Race : (1) G. L. MacGillivray ; (2) J. M. Oxley.
12. Running Broad Jump : (1) H. H. MacFayden ; (2) K. L. Aitken.
13. 440 yards Race : (1) Harry Robertson ; (2) L. O. Horner.
14. Married Men's Race, 100 yards : (1) Ed. McCormack ; (2) T. Porter.
15. Running Hop-Step-and-Jump : (1) H. H. MacFayden.
16. Department Relay Race, One Mile : (1) Accounting Department: H. Robertson, H. MacFayden and F. Mulhall.

Gold Medal for Championship : Wm. McCaffrey.

NEW AUTOMATIC SWITCH.

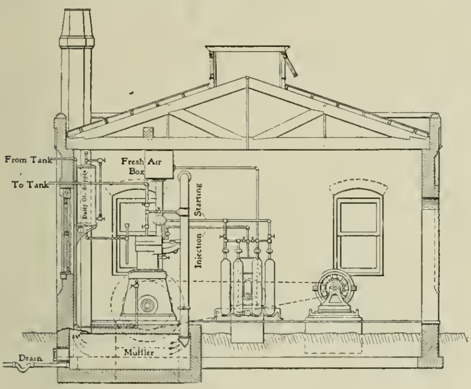
The Toronto Railway Company are experimenting with a magnetic switch which is expected to obviate the necessity of employing men at the junctions of streets, and also make it unnecessary for the motorman to turn the switch at any point. The switch is manufactured by the Baldwin & Rowland Switch Company, of South Norwalk, Conn., and is said to be in operation in many large cities in the United States. The switch turns itself, its automatic action being caused by magnetism. At the north end of the switch point a system of magnets has been put in under a heavy iron plate. Below the magnets about ten feet of the outside rail of the track is "dead," having no current through it. When the switch is turned against him the motorman stops his car just in front of the "dead" rail. As the car wheel touches the "dead" rail when the car moves again, a current is sent through the rail and the magnets are disturbed, causing the switch to move to the desired position.

OIL ENGINE CENTRAL STATION.

A radical departure from existing central station plants is afforded by the new electric light plant at Jewett City, Conn., a town of about 3,000 inhabitants. The new plant, which was started about the middle of July, has the distinction of being the first central station in the United States to adopt the Diesel oil-burning engine as its source of motive power, and represents an interesting example of elimination—no boilers, stacks, coal bins, stokers, economizers, or heaters being necessary. Compactness is the key-note of the whole design. Until the new plant was started, Jewett City was lighted electrically by a 60-k.w. Westinghouse 2,200-volt 60-cycle single-phase alternator driven by water-power at the Aspenock Bleachery. The claims made for the Diesel engine convinced the town authorities that a new station could be operated with profit, and the result, says H.S. Knowlton, in the American Electrician, represents one of the most advanced types of small lighting plants to be found in the East.

The power station is located on the west bank of the Pachaug River. A small brick chimney about 8 ft. high carries away the products of combustion discharged from the engine cylinders; before entering the chimney, the exhaust gases pass through a muffler.

The oil supply for the engine is drawn from two storage tanks set underground near the station. Their combined capacity is 6,500 gallons. The oil, which is crude, is brought to the plant in tank wagons holding 640 gallons, and costs 4·6 cents per gallon delivered. It is pumped from the main tanks to a vertical tank holding 40 gallons, and from this tank it is supplied to the engines.



Cross-Section View of Generating Room.

The generating plant consists of two 60-k.w. Westinghouse single-phase 2,200-volt 60-cycle alternators, belt-driven by two 75-b.h.p. triple-cylinder Diesel oil engines, of the vertical marine type. The engine cylinders are all 15 in. stroke and 10 in. diameter. The i.h.p. of each engine is about 100.

The engines constitute the most interesting feature of the plant and were built for the American Diesel Engine Co., of New York, by the International Power Co., of Providence, R. I. They operate on the well-known Otto cycle of admission, compression, combustion, expansion and exhaust, but differ radically from ordinary gas and oil engines in the character of the combustion. This is not of explosive character, but is steady combustion at high compression temperatures. During the compression stroke the cylinder contains air only, and the temperature due to compression ignites the combustible charge without the need of electric spark or ignition tube apparatus. The clearance is about 7 per cent. of the cylinder volume, and the combustion of the vaporized oil does not increase the pressure caused by the compression. The cylinders are symmetrically mounted on the engine housing and drive a single shaft through cranks having 120% displacement.

The valve operating cams are on the usual secondary shaft driven by the main shaft through an intermediate gear. The admission and exhaust valves are driven by two of these cams. The movement of the admission valve particularly is very slight. The oil is driven into the cylinders by compressed air through a series of perforated brass washers, and enters the cylinders in the form of a fine spray; an auxiliary air compressor, driven by belt from the engine, supplies the air for this purpose. The air which supports the combustion is drawn into the cylinder through an automatic mushroom valve, and is compressed on the up stroke to between 450 and 525 lbs. pressure per square inch, corresponding to a temperature of about 1,000% Fahr. The fuel valve is open for about one-tenth of the working stroke, and the fuel is let in and consumed during the whole or a part of this period as determined by the action of the governor. At the termination of the fuel supply, the resulting gases of combustion work expansively during the remainder of the stroke. The combustion is singularly complete on account of the large quantity of oxygen in the cylinder at the beginning of the working stroke. Any grade of crude or fuel oil may be employed in the engine.

The fuel oil is delivered to the fuel-admission valve by a pump driven from the cam shaft. One pump cylinder is provided for each of the main cylinders, and behind each is a by-pass valve, which, when open, allows the oil to flow again to the suction side of the pump instead of to the fuel valves. The length of time that these by-pass valves are open is controlled by the governor, which is of the centrifugal "Begtrup" type. The by-pass valves are opened by three arms pivoted at one end on a shaft which the governor raises or lowers. These arms are operated by connecting rods driven by eccentrics on the pump-driving shaft. By a link connection, the governor collar thus increases or lessens the distance between the top of the by-pass valve rods and the arms which open them. Upon the relative distance between the top of each valve rod and its corresponding arm depends the length of time the valves are open and the consequent duration of oil supply for combustion purposes.

After the fuel valve closes, the gases work expansively, and the atmospheric and terminal pressures differ but little. The effect of the compressed air used to inject the fuel is inappreciable. The admission valve is open a constant length of time, but the fuel supply is controlled by the governor as just described, so that only at full loads is it injected into the cylinder during the entire period that the valve is open. It has been stated that the thermal efficiency of the Diesel engine runs as high as 38 per cent.

In general outward appearance the engine resembles the ordinary marine type of steam engine. The connecting-rod is carried directly on a pin inside the piston, as usual in single-acting engines. The reciprocating parts are all enclosed within the engine housing, which is fitted with detachable plates for easy access. Lubrication is automatic, a large oil well in the lower part of the housing doing service as a bath into which the connecting-rod crank end plunges at every revolution. Double fly-wheels are provided for each engine in addition to the driving pulley.

The engines are started by compressed air from auxiliary reservoirs, which are filled by the engine-driven compressor already mentioned. The attendant opens a starting valve which admits compressed air to drive the piston for two or three revolutions, after which the compression in the cylinder is sufficient to ignite the charge; the starting cam is thrown out of action automatically as soon as the attendant throws in the admission and exhaust valve mechanism. Enough air is always stored in these reservoirs to enable the plant to start with ease.

The economy of operation shown by the Diesel engine is of interest. The machines in the new plant are guaranteed to operate on 0·47 lb. of oil per brake horse-power hour at full load, and on 0·5 lb. oil per brake horse-power hour from friction load to full load. With oil at 4·6 cents per gallon, this means about 1 cent per kilowatt-hour, including wages and supplies, the attendance required being very small.

The Armstrong Light & Power Company has been incorporated at Armstrong, B.C.

A by-law authorizing the city council of Calgary, N.W.T., to build and operate its own electric light plant was defeated by eight votes.

Papers were signed on September 12 by which the Kakabeka Land & Electric Company agrees to sell power to the town of Fort William, Ont., in any quantity at $18 per horse power per annum. The company will begin its work in one hundred days, and it agrees to have developed and to deliver to the town 5,000 horse power within two years. The city retains its franchise of light and water.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY
THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA
Telephone Main 2362.

BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions fr m foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:

J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.

1ST VICE-PRESIDENT:

K. B THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

2ND VICE-PRESIDENT:

A. A WRIGHT, M. P., President Electric Light & Power Co. Renfrew, Ont.

SECRETARY-TREASURER:

C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:

JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Mont eal Light, Heat and Power Co., Montreal.
A. A DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
GORDON HENDERSON, Sup. Cata act Power Co. amilton, Ont.
B F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.
C. K. GREEN, Superintendent Hamilton, Grimsby and Beamsville Electric Railway, Hamilton, Ont
CHARLES B. HUNT, Manager London Electric Co., London, Ont.
J. A. KAMMERER, Director Cataract Power Co., Hamilton.
H. O. FISK, Superintendent Peterborough Light & Power Co., Peterborough, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, CHAS. MOSELEY, - -	Toronto.
Vice-President, J. G. BAIN, - - -	Toronto.
Treasurer, A M. WICKENS, - -	Toronto.
Registrar, W. G. BLACKGROVE, - -	Box 531, Toronto.
Solicitor, H. CARSCALLEN, - -	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler, A. M. Wickens, F. W. Donaldson, J. G. Bain, W. G. Blackgrove.
HAMILTON, T. Elliott.
BRANTFORD.—A Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

AUXILIARY EXAMINERS—F. Simmons, Kingston; T. Wensley, Ottawa; R. Fischleigh, Bowmanville; W. Oelschlager, Berlin; W. A Matthews, St. Thomas.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, H. E. TERRY -	Toronto, Ont
Vice-President, J. R. UTTLEY, -	Waterloo, Ont.
Secretary, W INGLIS, -	Toronto, Ont.
Treasurer, J M. DION, - -	Toronto, Ont.
Conductor, F. W. SCUTTHORPE, -	Hamilton, Ont.
Door Keeper, J. OGLE, - -	Brantfort, Ont.

Conduit Wiring.

On going into the various small power houses dotted throughout the country, and also those engine rooms containing dynamos, one is struck by the poor appearance made by the wiring. This is in the main due to the fact that it has been put in on open knobs, instead of in moulding, or better still in conduit. Many purchasers have the good sense to spend a little extra money to purchase apparatus with a good finish and of pleasing lines, but spoil the whole effect by open wiring, which, while perhaps not cheap, can never equal the appearance of concealed work. Besides this question of looks there are also the items of reliability and safety, which are really more important. Wiring protected by conduit is safe from all ordinary causes of disturbance, and consequently the service is more likely to be uninterrupted. The extra cost on the total plant is practically negligible; why not put in what is absolutely the best?

A New Lamp.

As is well known by those who have interested themselves in the subject, the light-giving power of an incandescent lamp decreases with age, and, while the current consumption also falls, the two do not change in proportion. That is, the candle power falls off much faster than the current; in other words, the efficiency decreases as the lamp gets older. The argument is sometimes put forth that if the lamp is lighting the place required, and is taking if anything less current than at first, why disturb it? The answer is obvious after a little thought; if the decreased light which you are obtaining is sufficient for your purposes, why not put in a new lamp of that power, but which will give it you with less current consumption than your old one? The question is considered so important by many central stations that, in addition to purchasing their lamps under the most rigid tests and specifications as to maintenance of life, they regularly visit their various customers and remove those lamps which show less than a certain predetermined minimum of light. Recognizing the growing demand for this system of lamp renewal, the Bryan-Marsh Company, of New York, are now placing on the market an article which is an entirely new departure in this line, namely, a lamp which will automatically extinguish itself after its candle power has fallen to a certain fixed point. As at present constructed the apparatus is arranged to go out when its candle power has fallen to about eighty per cent. of the original, which takes place under ordinarily good voltage regulation in about 800 hours. The device is a decided novelty, and its progress will be viewed with great interest by all those who have to do with the manufacturing or operating of incandescent lamps.

Enclosed Fuses.

The question of the cost of electrical installations is one which naturally and rightly is given prominence when deciding upon the style and quality of the material to be installed. On the other hand, it is far from good policy to cut the cost of this down to the lowest practicable limit by putting in the cheapest possible material. Such a course is almost certain to mean that the labor will be of a corresponding grade, and that the two between them will make a completed installation presenting chances of dangerous shocks and fire risks which a but slightly greater investment would have totally eliminated. Particularly is this the case with fuses, which so often are still put in of the old open type, without cabinets or other enclosing device, many times without even a porcelain or mica cover. That immediately below them are piles and piles of the most highly inflammable material makes apparently no difference whatever. This construction was excusable perhaps when there was nothing better to be had, but the enclosed fuse is to-day, and has been for some time, ready to supply the demand. True, it has come rapidly to the front, but it is now a standard piece of apparatus, thoroughly reliable in its protective powers, and a great step in advance towards lessening the chances of fires. Surely nobody can afford, for the comparatively slight difference there is in the cost, to put in the open style when the other can be obtained. A few dollars may mean the prevention of a fire, cheap insurance, for no insurance, however heavy, really pays the total loss when you take into consideration the interruption to the service with its consequent loss of revenue and other accompanying worries.

Choice of Frequency. The choice of frequency in attenating current plants is a most important question, involving as it does in some cases almost the success or failure of the installation, and can only be decided upon after a full consideration of the points pertaining to the equipment and the uses to which it is to be put. Fortunately, there are in this country but a few standard frequencies, and almost all plants use one or the other, though this is far from true as regards European practice, where almost every conceivable periodicity is to be found at one plant or another. The standard high frequencies used here to-day are 133 and 125 cycles, in which event the generators are nearly always small, 200 k.w. or less, and are belt driven or direct connected to high speed water wheels; parallel operation when direct connected to engines is seldom or never attempted. The line reactance is, of couse, very heavy, which means that secondary networks must be small and the length of runs short. Transformers, as a general rule, are smaller and lighter, and therefore more efficient and less costly, the higher the frequency. Induction motors of these periodicities operate usually at higher speeds than those run on the lower frequency circuits, and are mostly single phase. If equipped with condensers the power factor is extremely good. Synchronous motors and rotaries of these frequencies are but seldom encountered, there being great liability to hunting except under the most favorable circumstances. Besides this, the high commutator speeds and the short neutral space, due to the close grouping of the poles, render the latter machine an almost commercial impossibility. Incandescent lamps are, of course, perfectly satisfactory, as is arc lighting, though in the latter case the power factor decreases as the frequency rises, and vice versa, the effect, however, being practically negligible To sum up the question, there is virtually no reason for further installations of these periodicities, unless it be to match apparatus already in place.

The next lower frequencies standard in this country are those of 60 and 66⅔ cycles, 7200 and 8000 alternations, which are classed among the low periodicities. They are those most generally used for lighting where power is also a necessity. Incandescent lamps are, of course, most satisfactory when operated from circuits of this type, as are also arc lamps, the power factor being slightly higher than with 125 or 133 cycles. They are also very suitable for induction motors and fair for those of the synchronous type and for rotaries, though in the latter case the objections of a short neutral and high commutator speeds are still very prominent. The hunting of synchronous motors has also to be carefully guarded against. As was noted when speaking above of transformers, their size and cost increase with a decrease in the frequency, a general rule obtaining for all periodicities. The reactance of wiring is not so pronounced, though still quite large if the heavier sizes are used, which makes it desirable to keep to the smaller gauges, especially if the runs are long. Parallel operation is quite satisfactory when engine driven through belts, or with any style of water wheel drive. When direct connected to engines the latter must govern within fairly close limits to prevent hunting.

Next below 60 cycles comes the frequency of 40, a periodicity used for motor work where some lighting is a necessity, and it is desired to provide for it with the least possible complication and outlay. The line drop is naturally not so great as at the higher alternations, but is still considerable, being 10 to 30 per cent. greater than the actual loss, depending on the size of the conductors used. Induction motors get heavier as the frequency decreases, but on the other hand the power factor is improved, and the possible maximum output, or the breaking down point, is higher. Synchronous motors begin to get more stable, so that the requirements of engines for driving direct are not so severe, either on this point or on the question of parallel operation. The same will apply to rotary converters, which also show better commutation. For lighting this frequency is satisfactory, though flickering begins to make its appearance on the higher voltage incandescent lamps, and also in indoor arc lighting.

The remaining standard frequency is 25 cycles, built in large and heavy units for power work, being always one of the multiphase systems, usually the three phase. Induction motors get heavier, in accordance with the general rule, but the power factors are better. Synchronous motors are most satisfactory, provided, of course, that the conditions are reasonably suited to this type of machine, as are also rotary converters, which can be built with most excellent constants. Incandescent lighting is practically prohibited, except with poor efficiency lamps of low voltage, and arc lighting is almost entirely out of the question. Parallel operation is of course entirely satisfactory, all descriptions of drive and prime movers being coupled in together, the requirements for even direct connected engine work being much less severe.

A new 2,000 light generator will be added to the electric light plant at Guelph, Ont., which has recently been taken over by the corporation.

The power house at Hanlan's Island, Toronto, was totally destroyed by fire on September 25th. The plant was used exclusively for lighting purposes, and together with building, was worth about $50,000.

THE CURTIS STEAM TURBINE.

That steam turbines will before long come into general use would seem to be clearly indicated by the advance that has been made in that direction during the past few years. The strongest point of the steam turbine, no doubt, is its efficiency in operation, it being claimed that it will operate as economically at half load as at full load. In a paper read by Mr. W. R. Emmet at the recent meeting of the American Street Railway Association, the author presents some interesting features concerning the Curtis steam turbine, the right to build which in Canada has been acquired by the Canadian General Electric Company.

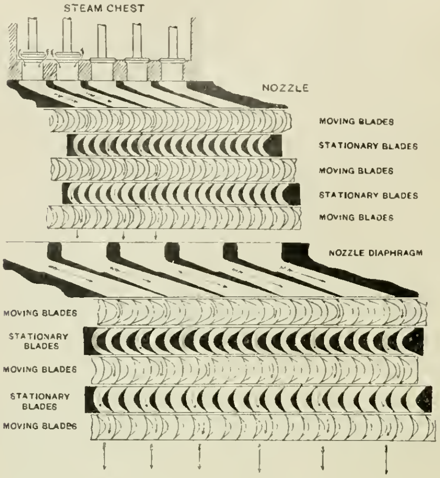


Diagram of Curtis Turbine in Its Latest Form

The General Electric Company, of Schenectady, N. Y., have erected a large addition to their works to be devoted entirely to turbine manufacture. They have recently installed a 5,000 kilowatt Curtis turbine in the new station of the Commonwealth Electric Company in Chicago. The design of this particular turbine embodies many radical changes as compared with other engines, turbines, or machines of any character. The shaft is vertical; the whole weight of the revolving part is borne by an oil film delivered by a pressure pump to the lower bearing; the delivery of steam to turbine is controlled through a system of electrically operated individual valves worked by a small controller, something after the manner of multiple-unit train-control system; the centrifugal governor moves the controller. The revolving field is mounted upon the same shaft with the turbine wheels, and the stationary portion of the generator is supported by the stationary portion of the turbine, the whole building up into the general form of a vertical cylinder about 25 feet high and about 14 feet in diameter. The total weight of the turbine and generator is about 400,000 pounds, and its capacity is 5,000 kilowatts at full load. It is capable of running at about 75 per cent. overload condensing and at nearly full load non-condensing.

Mr. Emmet says further: The question as to why the vertical-shaft design was adopted for this unit has often been raised and many doubts and criticisms concerning it have been expressed. It is not easy to explain all the reasons which led up to its adoption, but it may be said that the compactness and simplicity of this unit, which are its most marked characteristics, are largely due to the merits of this design. With the vertical-shaft arrangement all lateral strain is removed from the bearings which align the shaft and all deflection of the shaft is avoided with a minimum number and length of bearings. In the vertical design the space between wheels is reduced to a minimum, the supporting structure is perfectly symmetrical and cannot be in any way distorted or put out of line either by mechanical or steam-pressure strains or by the effects of expansion.

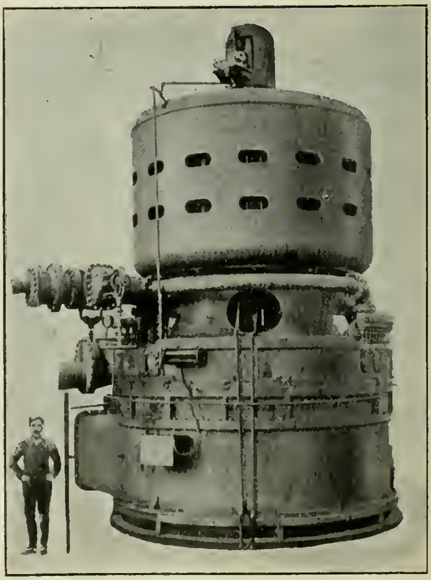
Thr oil-pressure step bearing at the foot of the shaft supports the whole revolving element in a balanced position by perfectly symmetrical suspension and preserves the exact relation of level between the stationary and revolving parts. As long as this step bearing fills its functions, a multitude of mechanical difficulties and uncertainties are overcome.

At the time this design was adopted there was no good precedent for the support in this manner of such a weight operating at so high a speed, and there were many predictions of failure, examples being quoted where similar methods had failed with waterwheels and other machines. It seemed clear, however, that with proper arrangements the operation of this bearing must be stable and reliable, and since forced lubrication was necessary to success in any case, it seemed advisable to put it where it would accomplish the greatest number of good results.

Experience with a number of machines has fully justified our decisions in this connection. The bearings have run perfectly with an inappreciable amount of friction, and when properly supplied with oil operate with perfect steadiness and regularity. In one respect these bearings have agreeably surprised us, that is, they have been much less injured by stoppages of oil than we expected. In the course of our experiments imperfect pumping arrangements have been used, and repeated failures of the oil flow have been experienced, but in no case has any damage to the machine resulted. Even the cast-iron blocks which constitute the step bearing are, as a rule, not destroyed. Our experience has been that they cut and heat when the oil supply is removed, but in all cases the surfaces have ground themselves to an operating condition after the oil flow is renewed so that the machine could be continued in operation. This might not always be the case, but it seems quite certain that the damage could never be as serious as that which would result from a failure of the lubrication system where heavy weights are carried on high-speed horizontal bearings.

In our newer machines we are providing a heavy stationary collar below the lowest wheel which can be used to support the wheels in case the step bearing is removed and which would serve as a break to bring the machine to rest in case the step bearing should cut enough to allow the wheels to settle to a dangerous degree. Our experience has been that there is very little tendency to settlement of the shaft in case of such cutting, and this latter function of the collar will presumably seldom be called into requisition.

The oil for step bearings and also for the upper bearings of machines is delivered by a small electrically driven pump, which operates continuously from the exciter circuit. In most of the large plants where we are installing turbines we have recommended in addition to these electrical pumps, a weighted accumulator, with steam pump arranged to keep it full automatically. This accumulator with its steam pump affords an automatic reserve for the lubricating system. Its capacity is such that there would be ample time to shut down the units, even if every-



5,000 K.W. Curtis Turbine Direct-Connected to Generator.

thing in the station should be stopped by the bursting of a boiler or steam pipe.

One important matter in connection with the intorduction of our turbines has been the establishment of proper condensing facilities in order that the great benefits of high vacuum might be realized to the greatest possible extent. In turbines which we have tested the steam consumption has been reduced from six to seven per cent. for every additional inch of vacuum above 25 inches. Such a reduction is, of course, very important and justifies large expenditures upon condensing apparatus. The fact that the turbine may be better than a condensing engine with equal vacuum must not be considered a reason for assuming that a condenser which is good enough for the engine is also good enough for the turbine. The selection of condensing facilities should be governed by the economic possibilities.

We have recently designed for some of our large new turbines surface condensers which themselves constitute the base and supporting structure of the machine. These condensers are of very ample cooling surface and so arranged that the maximum degree of vacuum is obtainable with a given amount of water. One feature of our turbine which is very advantageous in obtaining a high vacuum is that it can be easily so arranged that the air leakage is reduced to zero. The two points where the shaft passes through the casing are fitted with packings which are kept sealed by steam. Another advantage is that there is no oil in the steam, and consequently that the exterior of condenser tubes is kept perfectly clean. Several turbines with condenser bases are now being built, and it is probable that there will be a large production of machines of this type.

I have mentioned above that no oil comes in contract with the steam in these turbines, and I need hardly call attention to the great importance of this fact. The condensed water can be delivered directly back to the boilers, and all possibility of trouble in boilers from oil, dirt or scale is eliminated. Even in plants where feed water is good and cheap, this constitutes a great advantage, since a considerable amount of heat is saved by using the condensed steam on account of its higher temperature. There is, however, no such a thing as perfectly pure and clean natural water, and there are few boilers that in their average working condition are perfectly clean. Cleanliness in boilers improves circulation and evaporation, prolongs life and constitutes, therefore, a very distinct and definite advantage.

THE AMERICAN STREET RAILWAY ASSOCIATION.

The twenty-second annual convention of the American Street Railway Association opened at Saratoga Springs, N. Y., on September 2nd. In the absence of the president, Mr. W. Caryl Ely, the vice-president occupied the chair, and delivered an address full of timely suggestions. He stated that according to the last United States census report, there were on June 30, 1902, in the United States 987 companies, owning and operating 22,589 miles of single track, upon which were transported in that year more than four and one-half billion passengers, by the use of more than one and one-quarter million of horse-power. The aggregate mileage run by the cars used in these operations exceeded one billion miles. Referring to the possibilities of interurban electric railroads, he stated that there are now nearly 100 companies throughout the country engaged in the handling of freight and express business, and there are possibly many more which contemplate engaging in this work. There had been an improvement in station equipment and distributing systems, as well as in the character of the rolling stock. In this connection he pointed out that the Union Traction Company, of Philadelphia, contemplated an installation of ten 5,000 kilowatts in steam turbines. Alluding to the possible development of a single-phase motor for interurban railway service, he stated that up to the present time no reliable information had been available, and the electric railway engineers were still dependent upon the direct-current motor for interurban as well as city work.

In a paper on "Steam Turbines," Mr. W. L. R. Emmett presented valuable data regarding the development of that type of steam generator. The paper was followed by an interesting discussion, in which Mr. John I. Beggs, of Milwaukee, referred to the gas engine as a new power which may as far surpass the steam turbine as the steam turbine surpasses the reciprocating engine at least so far as the matter of economy goes. If the predictions made for the gas engine, in using gas now produced as by-products, or in using the ordinary illuminating gas, or producer gas from plants installed in connection with steam plants, were carried out, it would be possible to cut the cost of a kilowatt of current no matter how high the economy of the plant may be—it could be cut in half and possibly reduced two-thirds in cost. He regarded this as an important question. A large engine building concern of the United States had recently acquired the right to build the Nurenburg gas engine and proposed to have one of these engines installed in St. Louis twelve months hence. Where the cost of coal is such a factor that consumers are paying $3.50 per ton for screenings, where four years ago it could be obtained for $1.70, it was easy to appreciate any device which would bring down the cost of producing steam.

The chairman alluded to the fact that in the new plant of the Lackawanna Steel Company at Buffalo, by apparatus quite simple in its nature, the escaping gases from stacks of the blast furnaces and the ovens are recovered, washed and conducted to the engine room, where they are used as fuel, costing nothing to the plant, yet supplying fuel for an installation of 40,000 horse power of gas engines.

Other interesting papers submitted during the convention were: "Electrical Welded Joints," by William Pestell, superintendent of motive power and machinery of the Worcester Street Railway Company; "The Maintenance and Distribution of Alternating Current for Large Cities," by Richard McCulloch; "The Evils of Maintenance and Champerty in Personal Injury Cases," by Michael Brennan, Counsel of the Detroit United Railway; "Train Orders and Train Signals on Interurban Roads," by C. A. Coons, superintendent of transportation International Railway Company, Buffalo; "Freight and Express on Electric Railways," by J. B. McCleary, manager of the railway department of the Birmingham Railway Light & Power Company, Birmingham, Ala.; "The Right of Way," by H. H. Vreeland, president of the Interurban Street Railway Company of New York; and "Comparative Merits of Single and Double-Truck Cars for City Service," by John I. Beggs, Milwaukee Electric Railway & Light Company, Milwaukee.

The question of changing the name of the Association to the American Electric Railway Association was referred to the Executive Committee, who will also decide the matter of the next meeting place. The secretary reported the membership to include 206 companies.

The Canadian delegates to the convention were as follows: C. K. Green, W. T. Marlatt, Hamilton Electric Light & Cataract Power Company; P. J. Myles, Westinghouse Traction Brake Co., Hamilton; E. McKenzie, Toronto Railway Company; B. B. Jenkins, Revolving Sander Company, Toronto; F. E. McCollum, Momentum Brake Company, Toronto; G. Stevenson, Revolving Sander Company, Toronto; J. A. Currie, C. E. A. Carr, E. B. Carrington, London Street Railway Company; T. W. Casey, H. H. Lockwood, W. G. Ross, Montreal Street Railway Company; H. D. Bayne, Montreal, Que.; G. U. G. Holman, H. H. Morse, Levis County Railway Company, Quebec, Que.; W. Phillips, R. R. Knox, Winnipeg Electric Railway Company.

NEW WESTINGHOUSE OFFICES.

The New York offices of the sales organization of the Westinghouse Electric & Manufacturing Company, consisting of the New York Sales Department, Department "I", the Export Department, and the General Agent's Office, have been removed to the new Hanover Bank Building, corner of Nassau and Pine Streets. The new offices occupy the entire seventeenth floor of this building, one of the finest and best equipped office buildings in the country, where the arrangements and facilities will be of the best, both for the representatives of the company, and the public with whom they do business. The mail address of the several departments of the sales organization in New York will be No. 11 Pine Street.

The Executive, Financial and Stock Transfer offices will remain on the fouth floor of the Equitable building.

The present organization of the Westinghouse Electric & Manufacturing Company has been quartered in the Equitable Building since 1889, but the rapid and material increase of business has made the above move necessary.

A. L. and G. H. Voucher, electricians, have started business in Winnipeg.

The Board of Commissioners of Fort William, Ont., will ask for an additional $15,000 with which to complete the improvements to the power plant controlled by the corporation.

QUESTIONS AND ANSWERS

"Enquirer": Would you be kind enough to give me a short rule for remembering the different sizes, etc., of wires, supposing one had not got a table handy?

ANS.—We are not sure that we exactly understand your question, but the following is probably what you want. Namely: Starting with No. 10 wire, it is easy to remember that the diameter is 100 mills (it happens to be the square of 10,) and that therefore the circular millage is 100 x 100 = 10,000 C. M. Further, it has a resistance of 1 ohm per 1,000 feet. The weight is the only odd quantity to memorize, being 31 1/3 lbs. per thousand feet, bare. For the other sizes it is easy to remember that the diameter is halved every sixth size smaller, and as the circular millage is the square of the diameter, the former is halved for every three sizes decrease. Further, the table being arranged as a geometrical progression with a ratio of 1.26, the circular millage of any given wire, multiplied by 1.26, will give the circular mills of the next larger size. It should be noted that the above is true only of the B. & S. gauge table, and that the data given on No. 10 wire is not absolutely correct, though sufficiently so for all practical purposes. Weatherproof wire will average 25 to 35 per cent. heavier than bare, depending on the size and the maker.

"Manufacturer": We have a compound wound direct current 500 volt motor running a rock crusher, and it frequently stops and tries to run the other way, when it blows the fuses and shuts everything down. What is the trouble and how can we remedy it?

ANS.—The difficulty is due in all probability to your having the series coils connected so as to oppose the shunt winding, and when the load gets heavy they are strong enough to overcome the shunt and thus reverse the polarity of the field, which makes the armature run the other way. The remedy is to reverse the series field connections.

"R.F.," Montreal: I have a fan which is to deliver 8800 cubic feet of air per minute, at 3 ozs. pressure. Will you please advise me the size of motor required to drive it, showing how you calculate it?

ANS.—The horse power output from any fan is

$$\frac{\text{Vol. of air in cub. ft. per min.} \times \text{lbs. pressure} \times 144}{33000}$$

In your case this is $\dfrac{8800 \times 3/16 \times 144}{33000} = 7.2$ horse power.

Assuming that the fan has an efficiency of 80 per cent. the horse power input into the fan, or the power required to drive it, would be $\dfrac{72 \times 100}{80} = 9$ horse power.

"Engineer": What is an automatic engine? I always understood it to be one which had a governor on it, so as to automatically keep the speed right.

ANS.—The explanation which you give, namely, that any engine equipped with a governor, to keep the speed at the required point, is not correct, though it is popularly held to be so. An automatic engine is one equipped with that style of governor which automatically changes the point of cut off of the steam valve, so as to adjust the supply of steam to the work to be done. Engines which are provided with throttling governors, usually controlled by a pair of fly balls, and which thus wire draw the steam, instead of cutting it off completely, are not automatic engines.

"Ned": In alternating current work what is a reaction machine, a commutator motor and a repulsion motor?

ANS.—A reaction machine is one which excites itself by the reaction of the currents in the armature upon the field; it may be either a synchronous motor or a generator. Alternating commutator motors are those types which contain a commutator, as opposed to those, such as the synchronous and induction, which do not. The repulsion motor is one of the commutator motors, and gets its name from the principle employed to produce rotation, namely, the repulsion existing between the field and armature currents, the former being energized from the primary circuit, the latter being carried through brushes bearing on the commutator and arranged to short circuit the proper coils at the desired instant.

"J. M.": I have been told that in employing a synchronous motor to raise the power factor of a system, that it is possible to put such a machine in and do work with it, the total current taken by the plant being less when the machine is running than without it. Is this possible, and if so what is the explanation?

ANS.—The action of which you speak, which is apparently impossible, often takes place when to a circuit of underloaded induction motors there is added an overexcited synchronous motor. The power factor in the first case is poor, due to the presence of large lagging currents; it is also low in the case of the overexcited synchronous motor, but the current is leading. The result is that the two combine to form a third current, the new load on the system, which has a power factor differing from both its components, and which may in certain cases be less in amount than either of its components. The converse of this proposition is equally curious, namely, that you can shut down the synchronous motor, when the current consumption of the system will immediately rise.

"Electrical Contractor": What is the usual rule for installing arc lamps, that is, how do you calculate how many it takes to light a certain sized building? What is the best kind of globe to use, clear or frosted?

ANS.—The kind of building will affect the question very materially, but for ordinary manufacturing purposes a 450 watt lamp will cover 200 to 250 square yards. For offices and stores this may be somewhat decreased. On the other hand, for outdoor work the area is very much greater, being figured at about 2000 square yards per lamp. For this latter class of work it is usual to put on a clear outer and an opal inner globe, the latter being used to eliminate shadows and sharp rays from the arc. For indoor work both globes are frequently made frosted, though in that case you loose a good deal of the light, as each will cut off 40 per cent. of the light passing through it, whereas the clear globe stops only about 10 per cent.

THE INTERNATIONAL TRANSIT COMPANY AND TRANS-ST. MARY'S TRACTION COMPANY.*

By G. W. Chance.

The lines of these companies are situated in Sault Ste. Marie, Mich., and Sault Ste. Marie, Ont. Each place has a population of about 15,000 and is the center of a large water power development comprising a present development of 40,000 h. p. on the American side and 20,000 h. p. on the Canadian side, controlled by the Consolidated Lake Superior Company, which also controls the lines of the railway and ferry herein described.

The industries of the two sides comprise those largely connected with the Water Power Companies, but in addition on the American side are large lumber mills and tanneries. On the Canadian side there is a large steel plant, two blast furnaces, a rail mill with a capacity of 600 tons a day, a ground wood pulp mill with a capacity of 100 tons a day, a sulphite pulp mill with a capacity of 50 tons a day, also a reduction works, alkali works, a large saw mill with a capacity of 100,000 feet a day, and a veneer mill. On the Canadian side these industries are all located in the western part of the town.

St. Mary's Falls separates the two towns and is immediately below the International Bridge, which is the connecting line between the Canadian Pacific Railway and the Duluth, South Shore & Atlantic Railway and the Soo Line. Both of the latter railways are on the American side.

The length of track at present laid on the American side comprises about 8 miles, including sidings; an extension of 1¼ miles is contemplated to the village of Algonquin, a short distance west of the main town. This place has a population of about 800.

The present eastern terminus of the railway is at the ship-yard known as "Pullar's", where a large paper mill is contemplated and has been started. At this end of the town is located the County Club, Base Ball Parkf and the proposed race-track. The line on the American side runs mainly east and west following the lines of the river, with a belt line around the back part of the town into the residential district running out Ashmun street, which is the principal business street.

The car barns are located on Easterday avenue, on the belt line, and on the south side of the power canal, which runs through the center of the city.

The lines on the Canadian side have for their western terminus the village of Tagona, at which point is located the steel works, and at the east end terminate at the boat club, which is in the residential district.

The car barns on the Canadian side are located at the western end of the line in the village of Tagona.

FERRY.

On the American side the railway runs down to the river and has terminals on the dock immediately west of the power house of The Michigan Lake Superior Power Company, and from thence to Canada the connection is made by a ferry boat with a 20 minute service. This ferry is owned by the Street Railway Company.

The landing in Canada is at the foot of Brock street, which is in the center of the business district.

The route which the railway follows on both sides of the river is very interesting for strangers and tourists, and on the American side runs directly past the great locks of the U. S. Government, through which passes the greatest tonnage in the world. The length of lines on the Canadian side comprises 4 miles.

CHARACTER OF CONSTRUCTION.

The track is all laid of A. S. C. E. 80 lb. T rails, with Bonzano joints, four bolts to the joint. The turn-outs all have automatic spring switches, avoiding all necessity of turning switches, inasmuch as the traffic follows the switches throughout.

The ties are spaced 2 feet on centers and are cedar 6 in. x 8 in. x 8 ft. long and all curves have tie plates or braces. The track generally is located in macadam streets, and in all cases has at least 6 inches of crushed stone ballast under the ties except were the track is laid on the side of a street in the outskirts, where it is laid on gravel ballast.

The special work on the American side was furnished by The Falk Company, of Milwaukee, Wis., and on the Canadian side by the Pennsylvania Steel Company for the car barns, whereas the other special work was manufactured by the company itself at the shops of the Algoma Iron Works.

OVERHEAD WORK.

The overhead work is constructed in a most substantial manner. The poles are all of native Michigan cedar, very straight, not less than 7½ inches at the top and all painted a dark bronze green with white tops, which present a very neat and attractive appearance.

The cross span wire is ⅜ inch galvanized and the pull off wire ¼ inch. All the overhead fixtures are those of the Ohio Brass Company; on the Canadian side "Detroit ears" are used and on the American side a heavy "clinch ear" is used. All the trolley wire is Fig. 8. The feeder wire used is 300,000 C. M. weather proof copper wire. On the American side there are two miles of feeder and on the Canadian side the same.

BONDING.

The bonds used are those of the Mayer & Englund Company, of Philadelphia, and are known as the "foot bond", the terminals being placed in the base of the rail and the bond being of a horseshoe shape; the capacity of these bonds is 0000.

The contractors for the construction work on the American side were The Falk Company, of Milwaukee; on the Canadian side the contractor was J. H. McKnight, of Toronto.

CAR BARNS.

The car barns on each side of the river are practically the same in construction and size. The main building is 65 feet x 153 feet, with a large wing for offices.

The repair shop is located in the barn proper.

There are four inspection pits in the barn.

The side walls are brick; the front stone, and the building has steel roof trusses with corrugated steel roofing; the interior of the building is finished in white, while the outside of the roofing is painted dark green —graphite paint.

There is 3 inch pine flooring all over the building inside the car barn proper and the machine shop is separated by corrugated steel from the storage part proper.

EQUIPMENT.

On the American side the equipment consists of 6 semi-convertible cars designed by the manager of the road and built by the St. Louis Car Company. The cars are 32 feet over all and will seat 32 to 36 people.

---

*Since this article was written the Consolidated Lake Superior Company have encountered financial embarrassment but no doubt arrangements will be made to continue the operation of the electric railway as well as the many other important industries controlled by the company.

There are four cross-seats on each side in the center of the car and in each end longitudal seats. The cars are equipped with electric bells and have Ohmer fare registers, and are all equipped with equipments of Providence fenders, type "C". The inside finishing of the car is in oak and the outside is painted vermillion for the body color and the upper part a citron shade.

The electrical equipment consists of two No. 49 Westinghouse motors to each car, with two K10 controllers and circuit-breakers. The trucks are of the Dupont pattern; the wheels have 3 inch treads, ⅞ inch x 1⅛ inch flanges.

On the Canadian side the cars were built by the Ottawa Car Company, from designs by G. W. Chance, manager of the road. They are eight in number, 42 feet over all, and are of the semi-convertible type.

The trucks are Brill No. 27 G, equipped with four C. G. E. No. 67 motors, and the cars have two K6 controllers to each car, together with circuit breakers.

The cars have five cross seats on each side, made by Hale & Kilburn, of the Walkover pattern, covered with Pantasote, and on each end the seats are longitudal covered with rattan. The cars are equipped with the Momentum brake, manufactured by the Momentum Brake Company, of Toronto. These brakes are very effective and consist in two disks with wooden rubbing services and cast iron construction in general; a sheave and winding chain throws the brake on.

The cars on the American side are equipped with Sterling safety brakes with bevel gear attachment at top of brake staff.

The cars on the Canadian side are painted similar to those on the American side, vermillion body, citron upper part. There is a travelling trolley used on the cars on the Canadian side.

It is intended to add three large cars of the same pattern as those on the Canadian side for the American side, equipped with four Westinghouse No. 49 motors and K6 controllers.

FERRY DOCKS AND BOATS.

The company owns two docks, one on each side of the river, and on each are commodious buildings for ferry purposes. They also own two boats each with a carrying capacity of about 1000 people. One boat at present is used for the regular ferry service and the other one is an extra and excursion boat.

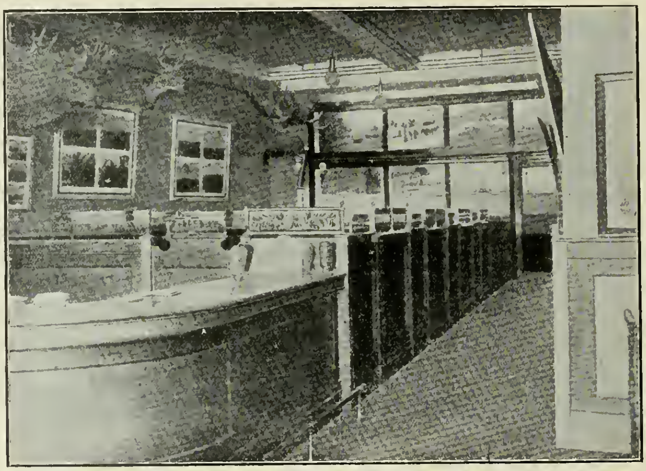
POWER.

On the American side the company takes power from The Michigan Lake Superior Power Company. The machines for this purpose are Stanley generators generating current at 600 volts. The water wheels are regulated by Lombard governors.

On the Canadian side the company takes power from The Lake Superior Power Company. The generators used were manufactured by the Canadian General Electric Company and furnish current at 550 volts. The water wheels are here likewise governed by Lombard governors.

NEW CANADIAN EMIGRATION OFFICES.

The remarkable growth of emigration from Great Britain to Canada has necessitated the erection by the Dominion Government of large new offices in London, England. These new offices, which were opened in April, are located at Charing Cross, in the centre of the Metropolis. They comprise a very imposing block of buildings of commanding appearance, and should provide adequate accommodation for the purpose for which they have been erected for many years to come.



New Canadian Emigration Offices, London, England.

The accompanying illustration shows a portion of the interior of the ground floor. It is partitioned off for various departments. The office of Mr. T. R. Preston, the Canadian Commissioner of Emigration, is on the ground floor. All the fittings are of Canadian wood, comprising bird's-eye maple, cherry, ash, and oak, the fittings having been mainly supplied by the Office Specialty Company, of Toronto, and the Canadian Office and School Furniture Company, of Preston. All the offices are admirably arranged to meet the work of this department, which now comprises quite a considerable staff.

The University of New Brunswick have decided to increase the tuition fees for engineering students from thirty to fifty dollars per year, but the proposed change will not be made until the beginning of the next academic year.

MONTREAL

Branch office of the CANADIAN ELECTRICL NEWS,
Imperial Building.

October 6th, 1903.

Contracting business, which has been pretty dull in Montreal since the latter part of June, is again picking up.

Amongst trade visitors lately in Montreal were Mr. Johnston, representing the American Marble & Toy Company, of Akron, Ohio, and Mr. C. B. Fewings, representing the McDonald & Wilson Company, of Toronto.

Montrealers in their private capacity will begin to find soon that it does not pay to have their Aldermanic representatives too attentive to civic arc lighting franchises and lose sight of incandescent for private consumption. It would seem that the Montreal Light, Heat & Power Company will shortly reimbure the low cost of arcs from incandescent and power. The discount on incandescent, formerly 33⅓ to 40 per cent., will shortly be reduced to 5 per cent. or 15 per cent. for a five-year contract. In some cases motor power has already been advanced from $60 per horse power per annum to $100.

Wild schemes are floating in the air as to new companies being formed. One is to utilize the water power at the dam at Carrillon on the Ottawa river; another to bring it from Massena, &c. Mr. W. MnLea Walbank, formerly manager of the Lachine Rapids Hydraulic Company (absorbed by M.L.H. & P. Co.), was coupled to various schemes, but this gentleman publicly denies any connection with such, which can therefore be taken as existing more in a desire than an actuality, or surely Mr. Walbank's statement would have mentioned whether he had been approached or no.

Mr. Phelps, of Baltimore, has been engaged by the city to report on a conduit scheme so as to get rid of some of our forest of unsightly poles. This expert proposes a common conduit of brick, to be built and leased "per duct per mile" by the city, the charge for rental being based on "interest on the expenditure." Some local electricians doubt the feasability of a common conduit of this nature on account of our severe climatic conditions. They also seem to think the cost to construct will be high, owing to the quantity of rock substrata which exists. There can be no two opinions, however, on one point, and that is that if built by the city the cost is almost sure to exceed any figure at which it could be done by either the existing companies or a specially formed conduit company for the purpose. However, several speeches miles long will have to be delivered as yet before anything practical is arrived at by our worthy city representatives.

The Bank of Ottawa's new building is in the hands of Mr. H. C. Stone, architect. Tenders are now being called for the electric wiring of same in iron conduit.

It is said that the Eugene F. Phillips Electrical Works are looking for a new factory site, having outgrown their present building and being unable to extend any more in their present locality. It has been a matter of night and day work with them for some time to try and keep pace with the orders in hand for weatherproof and other wires which they manufacture.

The usual fall busy season came to hand about September 1st as usual, and there are few complaints relative to lack of orders. The contractors complain of a lack of really competent wiremen, the reason probably being that there is more remuneration for them on the other side of the line.

Messrs. T. Pringle & Son, mill engineers, are superintending the construction of two large additional buildings for the Dominion Oil Cloth Company of this city. They are asking for tenders for electric light wiring for the buildings.

As a visitor remarked—"one cannot hear himself think for the noise of your cars." Certainly Montreal takes the medal for "roarers." The Montreal Street Railway might take a leaf from the book of Quebec, Toronto and Ottawa, and try to improve matters along this line. Why the Bell Telephone Company have not taken action before this for affecting their service is a wonder, as many a telephone subscriber requires to stop his conversation until the "noisy car" goes past.

A Boston manufacturer was surprised that we could buy so many electrical fittings to better advantage in Canada. There's a heap more surprises coming to him soon on this count.

Mr. Ernest Craig, who is leaving the Standard and Citizen Companies for Niagara Falls, is one of our pioneers, and kept circuits going in the old times when machines did not prove as tractable as they do now. Quite a few remember Craig's "Bernstein" incandescent circuits which lit the suburbs of Westmount and St. Cunegonde. The Craig station was located in the latter place, where Mr. Craigs senior, and Mr. Ernest Craig waged incessant warfare with the then Royal Electric Company for the lighting franchises of suburbs, and with a fair measure of success. Finally, the Royal Company bought out Messrs. Craig's station, and Mr. Ernest Craig then shortly afterwards did good work for the Citizens' Light and Power Company with the steam station at Cote St. Paul. The Citizens' Company affiliated with the Standard Company, both came under the regime of the Lachine Company, and now finally all are merged with the Montreal, Light Heat & Power Company. It would be difficult to find an enemy of Mr. Craig and his many friends will be sorry to lose him from Montreal. He was thoroughly practical, and unlike some others, was not averse to imparting his knowledge to those less favored who sought his advice.

WATER POWER DEVELOPMENT FOR SHERBROOKE, QUE.

Messrs. Ross & Holgate, hydraulic and electrical engineers, of Montreal, were commissioned by the City Council of Sherbrooke, to Que., report upon the development of the Westbury Basin water power, situated about eighteen miles from the city limits. The report states that the minimum flow of the river is 40,000 cubic feet per minute and the head available 37 feet, the equivalent horse power being 2,800. They recommend the dividing of the power plant into three units, providing room for a fourth unit to be installed only when the minimum flow has increased. Each power unit is to consist of a three-phase 60-cycle 500 k.w. generator running at about 425 revolutions per minute and driven by two pair of turbines on horizontal shaft coupled direct to the shaft of the generator; separate duplicate exciters independently driven to be provided. The generators are to operate at a voltage of 2,000, which is to be stepped up to 20,000 volts and transmitted to the Sherbrooke sub-station, when the voltage will be stepped down for distribution of current throughout the city.

For a development of 2,500 horse power the cost is placed at $207,226, made up of $19,000 for hydraulic machinery, $42,800 for power station electrical equipment, $18,000 for sub-station, $87,550 for dams and work apart from machinery and lines, and balance for contingencies, engineering and superintendence. A second estimate is $188,526 and covers power house and other works for four units, only three of which to be installed at present. The power developed in this case would be 1,875 horse power. Estimate No. 3 covers power house and other works for three units, only two of which to be installed at present. The cost for a development of 1,250 horse power is placed at $150,973.

The relative cost per horse power delivered in Sherbrooke would be as follows: For 2,500 h.p., $82.89 per h.p.; for 1,875 h.p., $100.60 per h.p.; for 1,250 h.p., $120.80 per h.p. These figures, it is stated, do not give an estimate of the amount of power available for sale, as, due to the overlapping of the power demand for a plant of this kind, it is estimated that the horse power to be sold can safely be increased 50 per cent. above these figures, so that the commercial horse power available for sale in each case would be as follows: No. 1, 3,750 horse power, capital cost per h.p. $55.26; No. 2, 2,812 horse power, cost $67.07; No. 3, 1,875 horse power, cost $80.54.

ENGINEERING and MECHANICS

THE C. A. S. E. SECRETARY.

Mr. Walter Ingles, who was re-elected Secretary of the C. A. S. E. at the Berlin convention in August last, is a member of Toronto Branch No. 18, which he joined in 1892. He was financial secretary for two years and afterwards president of that branch. For some years he has been chief engineer for the Canadian Oiled Clothing Company, and resides at 554 Bloor street west. He is a well known Forester, having filled offices in both the Ancient Order and the Canadian Order. In re-electing him to the position of Executive Secretary, the members attested their belief that the duties pertaining to that office are well performed.

Mr. Walter Ingles.

FIELD COIL TEMPERATURES.

In a paper recently read before the American Institute of Electrical Engineers, M. Clarence Renshaw gives some figures showing the actual temperature reached in the field coils of an electric tramcar during its daily working. The temperatures in question were measured by noting the resistance of a coil of carefully calibrated wire embedded in the field coils whilst the latter were being wound. The observations made extended over two days, during which time the car made its ordinary service runs. At starting, on the first day the coils were found to have a temperature of 25½ deg. Cent., or 13 deg. Cent. above the surrounding air. This temperature gradually rose, and at the end of eight hours was 74 deg. Cent., at which figure it remained constant for the next eight hours, the maximum temperature rise being thus 64½ deg. Cent. During the following three hours, which were late in the evening, the air temperature fell, and with it the temperature of the coils, which was 70 deg. Cent. at the end of the day's run. This temperature fell during the night ; but on taking out the car for its next day's work, four hours later, this temperature was still 32 deg. Cent., or 20 deg. Cent. above the surrounding air, so it would seem that the field coils of these cars never get quite "cold" in actual service. When drawing a "trailer," the temperature rise was much more rapid than when the car ran alone, and in an evening run under these conditions a temperature of 98½ deg. Cent. was noted at the end of 1½ hours' run. With the removal of the trailer the temperature gradually fell, reaching 74 deg. Cent. at the end of three hours. The car used in the experiments was of the single-truck type, with seats for 28 passengers. It weighed 12 tons empty, and was fitted with two Westinghouse motors, designed to give a mean speed of 26 miles per hour on the level. The actual average speed, including stops, was 10.7 miles per hour. The average number of stops made was between four and five per mile, the average duration of which was four seconds, and the maximum 15 seconds. The passengers carried numbered 956 in a day of 18¼ hours, and the average load was 24.

ENGINEERS' BANQUET.

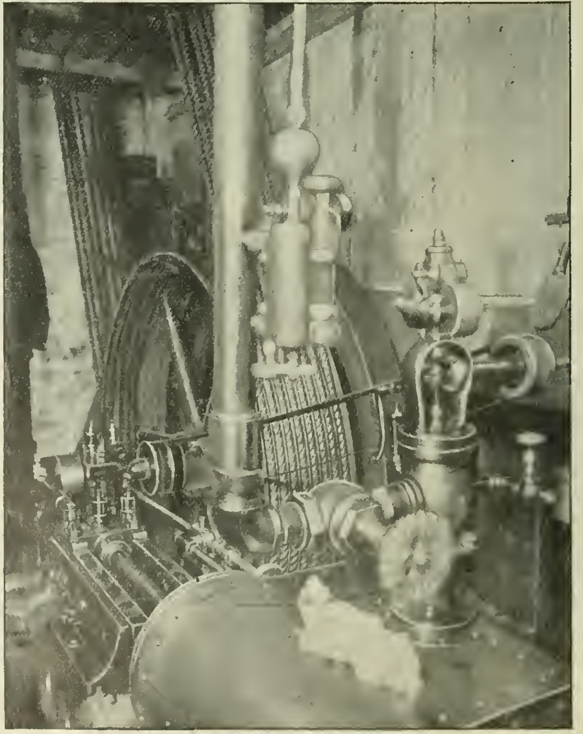
Arrangements have been completed for the annual dinner of Toronto N. I. C. A. S. E. to be held at the Walker House on Thanksgiving Eve, October 14. A good entertainment is promised by the committee, the personnel of which is as follows: G. C. Mooring, chairman; W. H. Johnston, secretary; J. G. Bain, H. E. Terry, J. Bannon, Alex. Storer, W. Oathwaithe and A. J. Butcher.

A 100 H. P. MAIN DRIVE.

As power users become more and more familiar with the advantages, economy and adaptability of the rope drive, as exemplified by the Dodge Continuous System, manufactured by the Dodge Manufacturing Company, of Toronto, Limited, installations of this drive become more and more numerous.

In the accompanying illustration we show a main drive of 100 horse power from the engine at the factory of F. Schryburt & Company, of Quebec, which is one of the drives recently installed by the Dodge Company, and which makes an exceedingly efficient drive.

The Dodge continuous rope drive is recognized for its efficiency and economy. It is both economical in first cost and in operation, runs noiselessly and satisfactorily and is wonderfully elastic--by its use many drives over obstacles and at difficult angles, which otherwise might be well nigh impossible, are easily accomplished.



Main Drive from Engine Room at Factory of F. Schrybert & Co., Quebec.

TELEGRAPH and TELEPHONE

RESIGNATION OF MR. H. P. DWIGHT.

On September 30th last Mr. H. P. Dwight retired from the active management of the Great North-Western Telegraph Company, after an unbroken service of fifty-six years. Mr. Dwight will still participate in the direction of the company's affairs, having retained the office of president. He has been succeeded as general manager by Mr. Isaac McMichael, a native Canadian who has been manager of the Minneapolis and North-Western Districts for the Western Union Telegraph Company, with headquarters at Minneapolis.

Mr. Dwight is in his seventy-fifth year, but still enjoys a splendid constitution. The story of his life is one of steady advancement from a telegraph operator to the presidency of the Great North-Western Telegraph Company, with 2,000 offices and 50,000 miles of line. He learned telegraphy in Oswego and soon became one of the best operators in the State of New York. On the 27th September, 1847, he took charge of the Kingston office of the Montreal Telegraph Company, but a few months later was promoted to Montreal, where he remained till 1850, when he came to Toronto. Mr. Dwight's executive ability was soon recognized and he was promoted to the positions of general assistant, general superintendent and superintendent in rapid succession. When the Dominion and Montreal Telegraph Companies were merged, under the charter of the G.N.W., in 1881, Mr. Dwight was appointed general manager of the united companies. Shortly afterwards he was elected vice president, and in 1893 was honored by election to the presidency.

TELEGRAPHIC SERVICE FOR PRINCE EDWARD ISLAND.

At the recent meeting of the Maritime Board of Trade, held at Charlottetown, P. E. I., Mr. F. L. Haszard, K.C., brought up the subject of the unsatisfactory condition of the telegraphic communication between Prince Edward Island and the mainland. He pointed out that part of the terms on which that province entered into the Dominion Confederation were that telegraphic connection with the mainland would be undertaken and maintained. There was now only a very poor service, for which excessive rates are paid. He had been told that the Government were considering the advisability of having a wireless telegraphic service installed.

Mr. George E. Hughes, M.P.P., said that for a part of the year the telegraphic service was actually their mail service, and there was no doubt but that a large amount of business was lost through the lack of the was proper communication. The following resolution adopted: "That in view of the fact that the telegraph service is one which is clearly the duty of the Federal Government to remedy, this Maritime Board of Trade expresses its regret that nothing has yet been done to remedy the grievances complained of, and strongly urge upon the Government its imperative duty to make the service satisfactory; and that the representatives from the Maritime Provinces be requested to press this matter on the consideration of the Government, so that immediate action may be taken, and that the secretary of the board be instructed to send a copy of this resolution to each of the Maritime representatives."

THE STATUS OF WIRELESS TELEGRAPHY.

The protocol adopted by the recent congress at Berlin, Germany, in regard to wireless telegraphy has been signed by the United States, Germany, Austria, Spain, France and Russia, but not by Great Britain or Italy. The principal provisions are that coast stations shall be constructed so as to allow communication with ships at sea regardless of the particular system carried by the vessel and the publication of technical explanations of all systems in order to facilitate the transmission of messages. It is also provided that it shall be the duty of all wireless systems to forward reports of accidents and requests for assistance. A universal system of charges is to be introduced. The services are to be so regulated that signal stations will disturb each other as little as possible.

The delegates from the United States to the Etheric Congress stated that owing to the laws of their country the American Government would not be able to prevent private companies from erecting wireless stations merely because they declined to exchange telegrams with stations belonging to another system. The delegates, however, have a general adherence to the principal promulgated by the majority of their fellow-confreres.

The British representatives dissented from a majority of the conclusions adopted. They affirmed that no system would be used unless a certainty of connections were guaranteed.

The Italian representatives supported the Englishmen, declaring that Italy could not repudiate its agreement with Signor Marconi. They added, however, that they would try to persuade him to modify his views on the subject in accordance with those of the majority of the delegates to the convention. The British delegates agreed to submit the conclusions of the conference to their Government, but expressed doubt as to the willingness of the English postal authorities to concede equal rights of all systems, owing to the legal status of wireless systems in Great Britain.

TELEPHONE NOTES.

The Bell Telephone Company has no less than twenty-seven miles of conduit in the city of Montreal, containing 648,266 feet of duct, besides another 100,000 feet of duct in the branches leading into lanes and other points of distribution. The company has found that while, generally speaking, the original cost of laying a conduit is five times as much as one of poles and wires, the expense of maintenance is only about 15 per cent., owing to the immunity from storms and other sources of damage existing above ground. The principal danger and cause of deterioration in underground stock so far, Mr. L. B. McFarlane says, has been found to be from electrolysis, as a result of so much electric current going back from the trolley car tracks to the power house. The current follows the lead coverings of the telephone cables, and where it leaves the electrolytic action sets in, resulting in the lead covering being eaten off the cable. Only the watchfulness of the company's engineers prevents serious damage in this connection. The most serious objectoin to the use of a commen conduit by low potential concerns like telegraph and telephone companies and high potential electric light and power systems, is well known to be the difficulty in maintaining complete isolation between the two, particularly in the manholes.

The city of Hamilton, Ont., have given the Bell Telephone Company an exclusive franchise for five years. The company is to pay $1,450 on the execution of the agreement and $2,900 a year for five years. The company agrees that it will not increase the rate charged the city or the Board of Education, the number of 'phones not to exceed 125. It also agrees to maintain and keep in repair without charge the poles and wires used in connection with the city police patrol system, and permit the city to use the cross arm on every pole for the fire alarm wires. Provision is also made that as soon as the switchboard is in operation all subscribers will be supplied with long-distance instruments free of charge, and that all agreements to pay extra charges for these instruments shall cease on January 1, 1904. The rates are fixed at $30 a year, unlimited calls for private residences; $25 a year and 2 cents a call, measure service plan for private residences; $20 a year, with an allowance of 100 calls each month, and 2 cents a call for all extra calls for dwelling-houses, on a party line not more than four on a line. The charges for offices or for houses used for trade, etc., $45 a year for unlimited calls; on measured service plan, $25 a year and 2 cents a call; offices on party lines, $35 a year with 100 calls a month, and 2 cents a call for all calls over 100 a month.

DISPLAY OF TRANSMISSION APPARATUS.

Among the many remarkable exhibits at the recent Toronto Exposition, that of the Dodge Manufacturing Company, Limited, of Toronto, was worthy of particular note.

The exposition of a complete rope drive from the main shaft in the building, exploiting with remarkable simplicity the Dodge continuous system, presented a clear demonstration of the exceeding efficiency for which it is so famous. Advantage was also taken of this opportunity to present to the public eye the Dodge travelling take-up carriage in its relation to the rope drive.

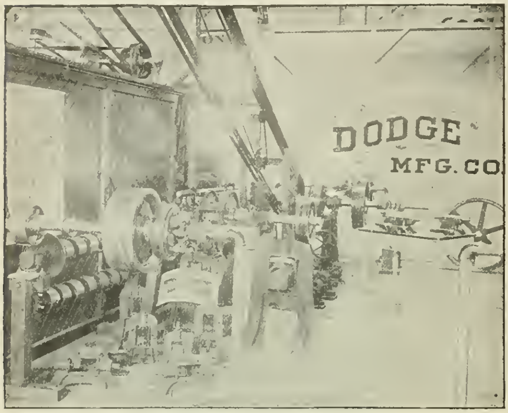


Exhibit of the Dodge Manufacturing Company at Toronto Exhibition.

The Dodge friction clutch, one of the company's many specialties, was attached to a piece of shafting which served as a railing for the exhibit. It was thus in a place convenient for the inspection of the many interested spectators.

Piled in great columns at one side were another of the company's specialities,—the Dodge split wood pulleys. The company was somewhat handicaped in this line of its exhibit, being unable to do itself justice, as only the smaller pulleys could be exhibited, the larger ones ranging as large as 30 feet in diameter.

The booth itself contained a display of the complete line of couplings, hangers, machine moulded iron pulleys, clutches, ring, chain and capilary self-oiling bearings, and a full line of grain and elevator machinery.

The exhibit as a whole did as much credit to the company as could be expected, since to demonstrate the true worth of the Dodge appliances would mean a matter of years, as any article of a mechanical nature can be shown while new in satisfactory operation, the only real test being found in subsequent years in their continued efficiency, freedom from repair, and long levity. And as the thousands of Canadian manufacturers testify, it is in these respects that the supremacy of the Dodge appliances is maintained.

IMPORTATION OF MACHINERY INTO SOUTH AFRICA.

A consular report says that the importation of machinery into South Africa is increasing, the total for the last fiscal year exceeding $4,000,000 in value, as compared with $3,000,000 for previous year. The steady extension of the railroads in South Africa accounts for the increased importation of locomotives, which were valued in the three years at $545,315, $1,148,095, and $1,963,253, respectively. New lines of railroad, estimated at 4,000 to 5,000 miles in length and to cost about $100,000,000 to $125,000,000, are projected. American manufacturing concerns are already in the field ; thus the Westinghouse Company has a contract for the construction of a line of roads in the De-Beers mining district. The General Electric Company, of New York, is to furnish to the railroad shops of the Natal Government 119 motors, 6 dynamos of 300 horsepower each, 3 electrical cranes, and other appliances. Another United States firm has received an order for 7 locomotives for the Cape Colony railroads. The municipal tramway of the city of Durban is being constructed by an American firm.

Whittaker & Company, 2 White Hart Street, Paternoster Square, London, E.C., have issued a valuable work entitled "Whittaker's Electrical Engineers' Pocket Book." The editor is Kenelm Edgcumbe, A.M. Inst. C.E., A.M.I.E.E., and the price is three shillings six pence net. This book differs in many respects from previous publications of a similar kind. It does not merely give a number of formulæ, rules and data, collected from various sources, but contains a kind of synopsis on each subject brought thoroughly up-to-date. The subject of dynamo design has been treated very fully and the section on "Estimating for Electrical Machinery" should be found useful.

The FIRSTBROOK BOX CO., Limited
King St. East, - TORONTO
MANUFACTURERS OF
TOPPINS,
SIDE-BLOCKS
AND CROSS-ARMS

WRITE FOR PARTICULARS.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS
HEAD OFFICE, TORONTO
Would be pleased to extend their usefulness by forming new branches in any district, town or city in Canada where seven or more members would be willing to join. Object : Mutual education and the building up of engineers in all branches of the work. Write for information. Address all communications to
W. INGLES, Executive Secretary,
554 Bloor West, Toronto.

FOR SALE

1–50 K W. S K C. Generator, 2000–1000 volts, 8000 alternations, with 2½ K.W. Exciter and Station Apparatus complete.
1–5 H.P. S.K.C. Motor, 8000 Alts., 500 volts, with necessary Transformer 1000–2000–500.
1–25 K.W. R. E. Co. B-iPolar D. C. Dynamo, wound for 110 volts, with sliding base, pulley, brushes, etc , complete.
2–12½ K.W. N. E. Co. Manchester Type Motor, wound for 250 volts, with base and pulley complete.
The above apparatus is all new and can be seen at the Hamilton Electric Light & Cataract Power Co's. Catharine street station, Hamilton. Will be sold en bloc or separately. For prices and terms address
THE VOLTA ELECTRIC STORAGE CO.,
39 James street South,
Hamilton, Ont.

McGILL UNIVERSITY, MONTREAL.
Courses in Civil, Mechanical and Electrical Engineering; Mining Engineering and Metallurgy ; Chemistry, Architecture. Also full courses in Arts, Law, Medicine and Veterinary Science.
For further information and for the University Calendar, address
THE REGISTRAR.

THE SYRACUSE SMELTING WORKS,
MONTREAL
Do not do business on catchy talking points only, the quality of our Babbitt Metal and Solder and the supremacy above other does it. Twenty-two years is our experience.
Our aim is the best, we have no competition if quality is considered.
Let us send you a sample order.

FOR SALE.
One 10 k.w., 250 volts direct current Royal Electric Co's. motor, in first class condition Can be seen by applying to 25 St. James St., Montreal. Will be sold at half the original cost.

WANTED
A 40 or 50 Light Arc Machine, 8 amperes ; Reliance type preferred THE BRANTFORD ELECTRIC & OPERATING CO. (Limited), Brantford, Ont.

MANGANESE of all kinds up to 95%.
Fluor Spar, Witherite,
Granulated Battery Sal
Ammoniac of High-Grade are offered by
OTTO MINNER & CO.,
Arnstadt, Germany.

The CANADIAN CASUALTY and BOILER INSURANCE CO.
Head Office : N. E. Cor. Adelaide and Victoria Streets, TORONTO.
Special Attention given to Steam Boilers
The Steam Boiler Policy of the Canadian Casualty and Boiler Insurance Co. gives Free of Cost—
Regular Inspection of Boilers, Free Insurance of Engineers and Firemen, Public Liability Protection, and the advice of our Consulting Engineers — FREE.
Write to-day for Booklet "To Steam Users."
ALEXANDER SUTHERLAND, D. D., President.
H. N BATE, W S. DINNICK, Vice-Presidents.
A. G. C. DINNICK, Managing Director
A. M. WICKENS, Chief Engineer.

PERSONAL.

Mr. Roderick J. Parke, electrical engineer, of Toronto, is at present on a business trip to British Columbia.

Mr. Thomas Ahearn, of Ahean & Soper, Ottawa, who with his wife and family spent the summer in Europe on a pleasure trip, arrived home early in September.

Mr. T. H. Creden, general manager of the Cape Breton Electric Company, has tendered this resignation to accept an important commission in Boston. He will be succeeded by Mr. E. S. Dimmock.

Mr. J. J. Wright, manager of the Toronto Electric Light Company, after spending three months in Muskoka, has returned home in greatly improved condition. His friends hope to see him again "on deck."

Mr. C. F. Beauchemin, who was prominently connected with the formation of the Merchants Telephone Company in Montreal, died at Farnham, Que., on September 26th.

Mr. Ernest Craig, who has been secretary-treasurer and superintendent of the Standard Light & Power Company and the Citizen's Light & Power Company in Montreal for the last ten years, has accepted a responsible position with the Toronto-Niagara Power Company at Niagara Falls.

Prof. William J. Sweetser has been appointed professor of manual training and engineering at Mount Allison University, Sackville, N. B. Prof. Sweetser studied manual training in the Cambridge School, one of the finest in America. He graduated from the Massachusetts Institute of Technology with the degree of B.Sc., having made a specialty of mechanical engineering.

Mr. W. H. Moore, assistant to the president of the Toronto Street Railway and general manager of the suburban lines, was seized with an attack of appendicitis while on a business trip to Ottawa last month. The attack rendered an immediate operation necessary. This was performed in the Protestant General Hospital, since which time Mr. Moore has made rapid strides towards recovery.

Mr. Samual Rogers, president of the Queen City Oil Company, died at his residence, 107 Avenue Road, Toronto, on Sunday, September 26th. Mr. Rogers had been in delicate health for two years, being troubled with an affection of the heart. He was 69 years of age and was born in North York, where Timothy Rogers, great-grandfather of the deceased, settled in 1800. Deceased established the Queen City Oil Company in 1877, his son, Mr. Albert Rogers, now being the acting manager. Mr. Rogers was a man of spendid business qualities and of wide charity. He is survived by a widow, two sons and four daughters.

SPARKS.

Whitby, Ont., is about to install an electric light plant. The work is in charge of Mr. R. E. Speakman, C. E., of Toronto.

The Bell Telephone Company have made a new proposition to the City Council of Ottawa, agreeing to enter into a five-year contract to furnish domestic instruments at $25 per year and to provide 50 instruments for civic use free of charge.

It is reported that Canadian capitalists have secured the Ruthenberg process of making steel by electricity and in the near future will construct a mammoth electrolytic steel plant on the Welland river at Chippewa, utilizing the Niagara power.

The Summerside Electric Company, of Summerside, P. E. I., have just installed a new Leonard Corliss engine of 200 horse power. The fly wheel is 12 feet in diameter, and the engine complete weighs about 30,000 pounds. The plant of this company is now up-to-date in every particular.

An Ontario charter has been granted to the Thornbury Gasoline Engine & Foundry Company, to manufacture gas and gasoline engines and motors, steam engines, electric motors, etc., at Thornbury, Ont. The promoters include Messrs. H. A. Carmichael, of Thornbury, and D. A. McDonald, of Glencoe.

Mr. A. J. Andrews, representing an American syndicate, has submitted a proposition to the city council of Winnipeg to develop the water power of the Assiniboine river. He guarantees to develop immediately 4,000 horse power and to furnish the city with what power is required at $40 per horse power per year for a 24-hour service.

Labor Day beat all previous records for street railway traffic in Montreal. Without counting transfers the company carried 321,419 passengers and the receipts totalled $13,939. The previous highest record was the first Monday in September of last year, when 263,794 passengers were carried and the receipts totalled $11,223.

A resolution introduced to the Dominion Trades Council providing for the licensing of stationary engineers, was referred back by the committee so that a limit of horse power should be fixed. It is proposed to restrict the license to 25 horse power and upwards, so that the regulation will not interfere with the employment of stationary engineers in rural districts and for threshing purposes.

TO THE TRADE

We are Building Some of the
Largest High Tension Switches
Ever Used in this Country. We
Can Build Yours.

The Hill Electric Switch Co., Limited, 426 St. Paul Street
MONTREAL

SPARKS.

The property of the Coaticook Electric Light & Power Company came under municipal control on October 1st. Mr. Bower, of Morrisburg, has been engaged to take charge.

Messrs. Cadmas & Coe, exporters, New York City, have recently purchased from J. C. Wilson & Co., Glenora, Ont., for a client abroad, the complete outfit for the equipment of a water power their customer is developing. The outfit is to consist of an 8-inch "Little Giant" water wheel, the necessary iron flume, shafting, gearing, couplings, flat and upright bearings, etc.

The Canadian Bullock Electric Manufacturing Company have secured the contract for the electrical equipment of the Sudbury Power Company. It embraces 100 k.w. in 3-phase generators, 60 cycle, two 40 k.w. exciters direct connected to water weeels, six step-up transformers, and three step-down transformers. The chief engineer of this work is Mr. T. T. Simoson, of Deschenes, Que.

The Montreal Star is authority for the statement that Messrs. Brown, McFarlane & Co., a Glasgow (Scotland) firm of turbine engine manufacturers, are making arrangements with the Canadian Pacific Railway Company for the installation of turbines in the latter's lake boats. Mr. McFarlane looks forward to the day when all steamships on the great lakes will be fitted with them.

Attention is called to the advertisement in this number of the Canadian Casualty & Boiler Insurance Company, whose head office is in Toronto. The managing director of this company, Mr. A. G. C. Dinnick, is a gentleman of wonderful ability and great business experience. He has associated with him the best possible men for the positions required in the inspection and insurance of boilers, etc.

An electric car ran at the rate of 108 4-5 miles an hour at Berlin, Germany, on September 17th, which is said to be the highest speed ever attained. The engineers in charge of the experiments expect that 125 miles an hour will be reached. It was found last year, when a speed of 99½ miles was achieved, that the 70-pound rails and ordinary ballasted roadbed would not stand the strain. Since then the roadbed has been reconstructed with broken basalt and closely set with pine ties faced with oak, so as to combine the springiness of the pine and the hardness of the oak. The new rails weigh a little over 100 pounds. Alterations have also been made in the motor. The details of the experiments are kept secret, but a summary of the results will probably be published at the end of the trials.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Date.	Light.	Date.	Extinguish.	No. of Hours.
Nov. 1	1 10	Nov. 1	6 00	4 50
2	2 10	2	6 00	3 50
3	3 10	3	6 00	2 50
4	4 00	4	6 00	2 00
5	No Light	5	No Light	.....
6	"	6	"	......
7	5 15	7	8 40	3 25
8	5 15	8	9 40	4 25
9	5 15	9	10 40	5 25
10	5 15	10	11 45	6 30
11	5 10	12	0 50	7 40
12	5 10	13	2 00	8 50
13	5 10	14	3 00	9 50
14	5 10	15	4 15	11 05
15	5 10	16	5 20	12 10
16	5 00	17	6 15	13 15
17	5 00	18	6 15	13 15
18	5 00	19	6 15	13 15
19	5 00	20	6 15	13 15
20	5 00	21	6 15	13 15
21	5 00	22	6 15	13 15
22	5 00	23	6 15	13 15
23	5 00	24	6 15	13 15
24	5 00	25	6 15	13 15
25	9 00	26	6 15	9 15
26	10 00	27	6 15	8 15
27	11 00	28	6 30	7 30
29	0 00	29	6 30	6 30
30	1 00	30	6 30	5 30
		Total	....	239 05

CHANDLER CANADIAN PATENT NO. 63721

We are prepared to receive orders for the manufacture of

ENGINES

covered by the above patent

Laurie Engine Company
Montreal, Canada

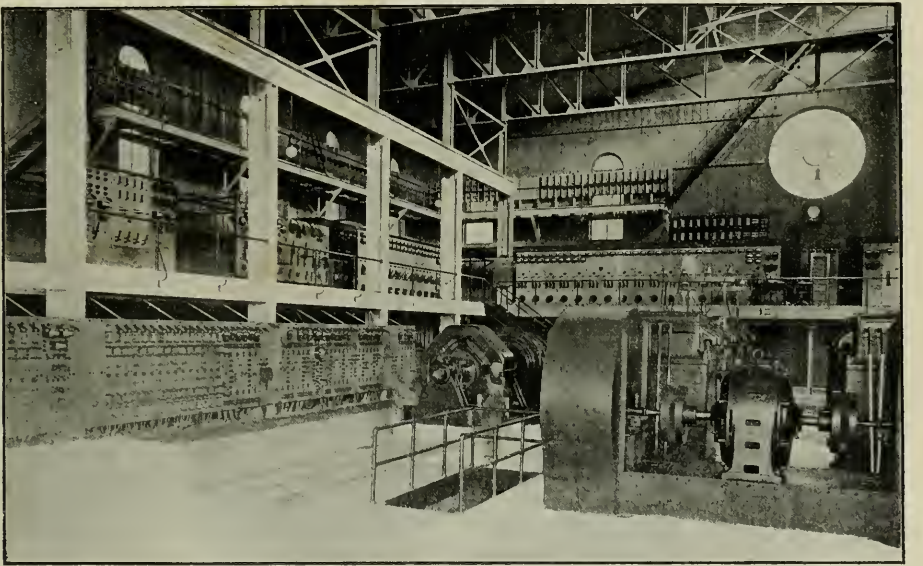
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIII. NOVEMBER, 1903 No. 11.

NEW TRANSFORMING AND DISTRIBUTING STATION OF THE MONTREAL LIGHT, HEAT AND POWER COMPANY.

BY J. A. BURNETT.

Coincident with the reconstruction of the Chambly hydraulic and electrical development and the acquisition by purchase of the Lachine Rapids, Hydraulic and Land Company on behalf of the Montreal Light, Heat and Power Company, the management of the latter company decided to abandon their 10,000 volt lowering transforming station on Prince street and to construct a suitable new transforming and distributing station of such size and capacity as to provide for future requirements. The demand for light and power in Montreal and its suburbs has within late years increased at a phenomenal rate.

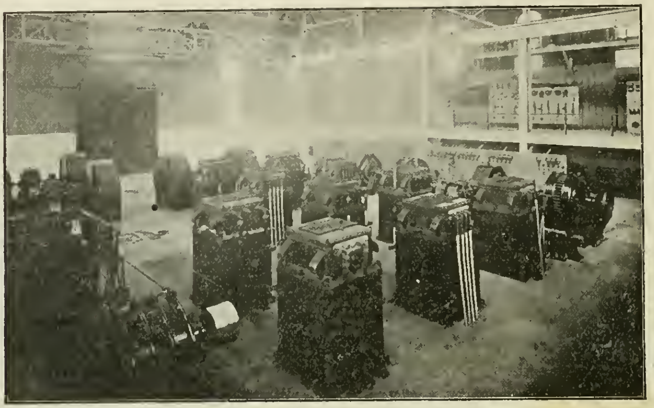


CENTRAL STATION, MONTREAL LIGHT, HEAT & POWER COMPANY—VIEW SHOWING INDUCTION MOTOR BLOWER UNITS AND SYNCHRONOUS MOTOR GENERATOR SETS; ON GALLERY CONTROLLING PANELS AND 27-PANEL FEEDER SWITCH-BOARD

Montreal being a city with favorable advantages for manufacturing, has seen existing manufacturing industries largely extended and new ones from time to time inaugurated. The use of electric power is favorably considered for such industries, especially as the Montreal Light, Heat and Power Company are in a position to and do quote rates to large users of power as to in most cases supplant steam power. Apart from the mere question of cost, the use of electric power presents such features as steadiness of operation, reliability and freedom from interruption, minimum expense for attendance, and economy of floor space. Such characteristics have therefore brought about the introduction of electric power in large industrial establishments in the city of Montreal and vicinity.

Prominent among such users of power are: Montreal Street Railway Company, using 4,000 k.w.; Dominion Cotton Mills Company, 2,500 k.w.; Canadian Pacific Railway Company, general shops, 1,500 k.w.; Canadian Rubber Company, 1,000 k.w.; Montreal Water and Power Company, 1,000 k.w.; Montreal Water Works, municipal, 500 k.w.

The above represent the larger users of power and the list is continued down to small but very numerous users, having motors for ice-cream freezers, dental laboratories, fans for cooling, horse clippers, wood chopping establishments, church organs, laundries in private residences, and elevators in houses where the inmates prefer such means of ascending indoors to the old-fashioned and more laborious method of walking upstairs. Altogether the application of electric power in Montreal is getting to be well nigh universal, and in the case of such establishments as the Dominion Cotton Mills Company it is an impressive sight to view the large mills of this concern, with some 1200 operatives, being entirely operated by electric power with a distant water-power as the prime mover.


Central Station, Montreal Light, Heat and Power Company—View Showing Ten 2,750 K.W. Transformers, Travelling Crane and D.C. Switchboard Panels.

The electrical power generated by water-power at Lachine, Chambly, and Shawinigan, and distributed by the Montreal Light, Heat and Power Company for lighting and industrial purposes, yearly supplants the consumption of the large estimated amount of 175,000 tons of coal, or 560 tons for every working day in the year, thus introducing into municipal matters an economic factor of basic importance. The necessity, therefore of a suitably designed transforming and distributing station for such a system is thus made apparent.

This station, designated by the company owning it Central Station, and one of the largest of its kind in the world, was commenced August 19, 1901, and by May, 1902, apparatus was being installed therein, work having been continued throughout the winter, except for a few weeks' interruption due to excessively cold weather.

The building occupies the block bounded by Wellington, Prince, Ottawa and Queen streets, a situation well adapted for distributing purposes. It is strictly fireproof and is at all points at least 80 feet distant from any neighboring buildings. The windows are provided with steel framings and ¼″ thick wired glass panes. Wood has as far as possible been carefully eliminated thoughout this building, only the doors at the Ottawa street end of the building being composed of this material.

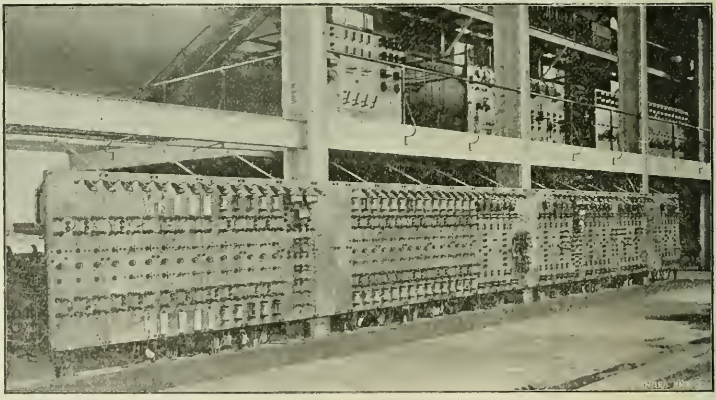
The heating of this structure is furnished to a great extent by the transformer internal losses, which at time of full load approximate 500 k. w.

Other features of this building are the ample width of switchboard galleries, 21 feet, and the liberal amount of daylight when such is available. The artificial lighting consists of rows of incandescent lamps suspended from the roof trusses and a row of a.c. arc lamps suspended over the switchboard galleries. An auxiliary gas supply is connected to gasoliers attached to the gallery hand rail. These are kept lit after dark, so that under no circumstances will the building be put in total darkness.

The switchboard gallery flooring is composed of 2½ inch slate laid on 15 inch I floor beams, spaced 4 ft. 2 in. centers. The main and basement flooring is of granolithic composition.

The outside walls of the building are constructed of Laprairie pressed brick. Inside for 10 feet is provided white enamel brick, and above that Milton brick of a pleasing buff color. The roof is very substantial, being 10 inches thick of terra-cotta, over which is applied a waterproof asphalt roof 1 inch thick. The building interior measures 118 feet x 122 feet 6 inches.

The apparatus installed comprises a 25,000 volt high tension, a 4,800 volt transformer switchboard, and a 4,800 volt distributing feeder switchboard. The high tension switchboard comprises four incoming line and five transformer primary panels. The transformer switchboard comprises five operating and two total output instrument panels. The distributing feeder switchboard comprises sixteen and eleven panels, each capable of controlling 1,000 k.w. at 4,800 volts. The circuit breakers with which these panels are pro-


Central Station, Montreal Light, Heat and Power Company—View Showing A.C. Arc Lighting Switchboard; on Gallery, A.C. Switchboard Controlling Transformer Blower Motors, D.C. Switchboard Panels, and 11-Panel A.C. Feeder Switchboard; on Upper Gallery, Lightning Arresters.

vided are automatic, the final break taking place in oil. These circuit breakers are intended to open under short circuit conditions and are inclosed in a brick walled cell, with 2 inch soap-stone cover. This feature is shown in Fig. 2.

On the ground floor and immediately under the distributing switchboard is located a set of 27 circuit breakers, similiar to those above. These are intended to handle grounded or defective circuits. This set is called the "emergency board." Each feeder panel is provided with a time element overload relay. These open the circuit-breakers under overload conditions. A feature of this board is the interlocking mechanism arrangements. This insures that a defective or grounded feeder must be removed from the main bus-bars before being thrown on to the emergency bus-bars or vice-versa.

Exterior of Central Station, Montreal Light, Heat and Power Company—This View Shows Exit of Overhead Feeders.

The high-tension switchboard is merely a selector board and its switches are only intended to open the transformer primaries under no secondary load conditions. The transformers are controlled at their low tension ends through single-pole oil-break circuit-breakers, each of 1,200 amperes capacity.

The high-tension switchboard is connected to the transformer primaries by means of a three conductor No. 0000 B. & S. gauge paper insulated cable, designed for 25,000 volts working. A section of this cable is shown in Fig. 3. The outside diameter of this cable is three inches. There is some 12,000 feet of this cable in use on the incoming lines, between the Central Station and the Victoria Bridge, and comprising part of the Chambly transmission line. In the Central Station this cable is run in brick trenches, as shown in Fig. 4.

A noticeable feature of this equipment is the bank of voltage lowering transformers, ten in number. These are of the air-cooled type, no oil being used for insulating; they are rated at 2750 K.W. capacity each, and are of the following dimensions: Height, 8 ft. 6 in.; base, 4 ft. 7 in. x 4 ft. 11 in.; weight, 24,000 lbs. They are the largest transformers in the world. A view of one of these transformers is shown in Fig. 1.

The heat generated by the iron and copper losses is taken away in the following manner: Three sets of induction motor and blower units are installed over a brick air chamber, measuring 65 ft. x 37 ft. x 8 ft. high. These blowers, six in number, have 32 in. x 32 in. down draft discharge outlets, and deliver air into the chamber at about ¾ to 1 oz. pressure per square inch. This air is blown down into the air-chamber, and then rises through the bases of the transformers, percolating through the copper and iron interior structure. This is shown in Fig. 5. The transformer bases have an opening 3 ft. 5 in. x 3 ft. 9 in. to permit of free air circulation. The permissable temperature rise for continuous operation is 35 degrees C. above the surrounding air. The ten transformers require 60,000 cubic feet of air per minute for cooling. This air is used for heating the building, as before mentioned.

The transformers are permanently connected in pairs; the primaries three phase 25,000 volts, the secondaries 2,400 or 4,800 volts, two phase, which is the system now in use by the Montreal Light, Heat & Power Company for distributing purposes. Each transformer secondary requires four 1,000,000 c.m. cables to carry its output to the transformer switchboard bus-bars. In running these cables, care had to be exercised to avoid iron clamps, due to the resulting heating effects. All bushings, etc., are of non-magnetic material.

This station also contains a complete switchboard for the alternating current arc street lighting, there being 30 constant current transformers and regulators, each regulating and supplying a fifty lamp circuit. Two motor-generator sets are provided for the D. C. power service. These sets consist of a Type 13 S. K. C. synchronous motor direct connected to a 200 K. W. D. C. multipolar 250 volt generator. These sets have switchboard panels separate from the A. C. switchboards before mentioned. A novel form of insulating

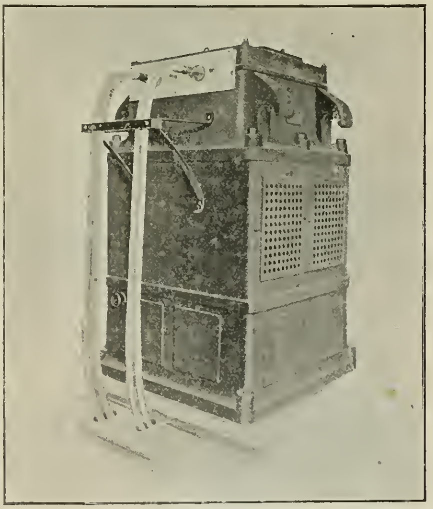


Fig. 1.—2,750 K. W. 25,000 Volt Westinghouse Air Blast Transformer—The Largest Transformer in the World.

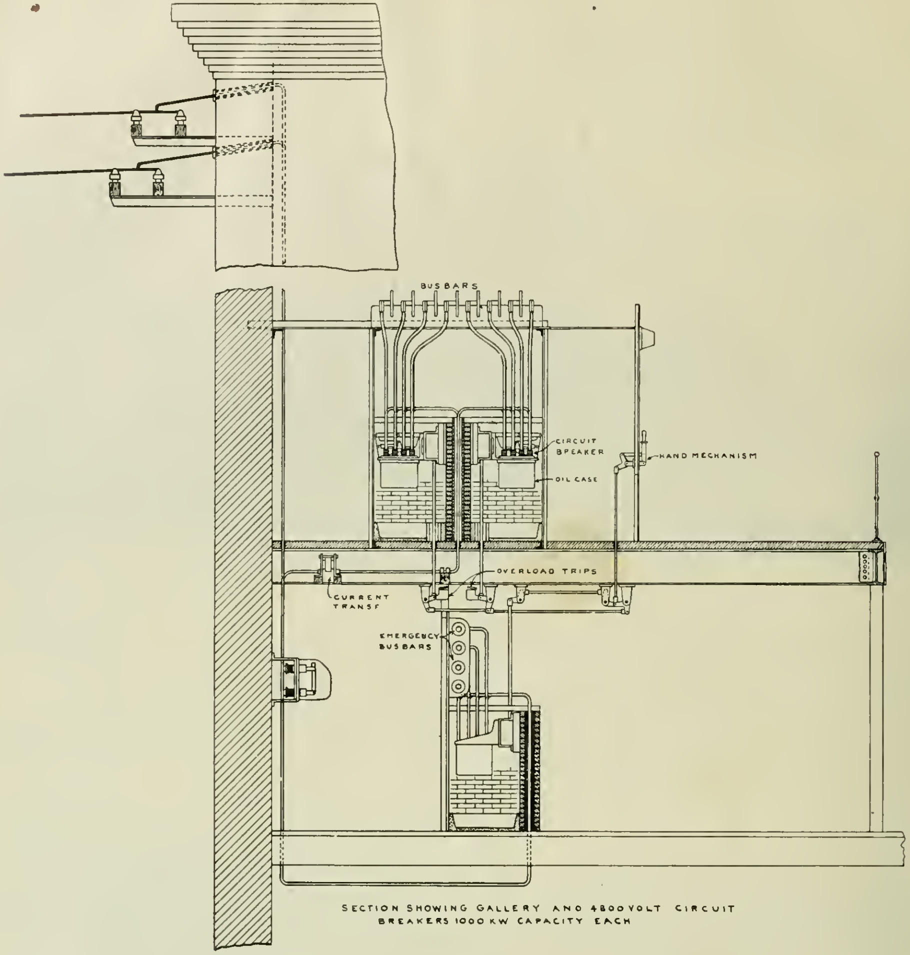


FIG. 2.

and flexible coupling is used on these sets and is shown in fig. 6.

The upper gallery shown on the illustration is intended for the lightning arrester equipment.

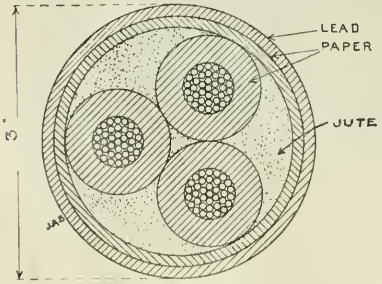


FIG. 3.—25,000 VOLT 3 CONDUCTOR NO. 0000 B & S GAUGE PAPER INSULATED AND LEAD COVERED CABLE.

A 15-ton capacity three-motor electric overhead travelling crane with a 73-foot span is used for picking up and handling station apparatus. A roomy basement is also provided with 8 feet headroom. This basement contains cable ducts and trenches for the switchboard and feeder cables. Lavatories and clothes lockers, as well as a gas stove for heating, are provided for use of the station attendants.

The output of this station is at present 27,500 k.w. and floor space is reserved for an ultimate installation of sixteen lowering transformers, or 44,000 k.w. Ample space is reserved for any desired switchboard extension considered necessary.

This station is served from the following sources :

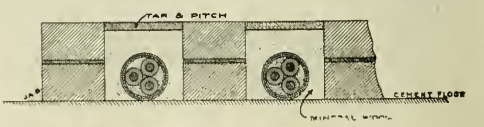


FIG. 4.—METHOD OF RUNNING 25,000 VOLT CABLE.

Lachine, Chambly, and Shawinigan ; the daily load reaching 25,000 k.w. around 6 p.m. A steam reserve of 5000 k.w. is also available and connected by suitable feeders to the distributing switchboard busbars. This steam reserve is contained in a station distant about 500 feet from the central station, and a smaller plant of about 1000 k.w. is contained in a station on Water street about two miles distant.

Fig. 2 shows the method adopted for the exit of the overhead lines. A series of floor tubes about 24 inches long were inserted in the walls during construction, and through these the feeders were run, the outside lines being deadened on the outside fixtures.

Figures relating to capacity and floor area are of interest. The floor area of the central station is 14,500 feet and the ultimate capacity 44,000 k.w., giving an output per square foot of floor area of some 3 k.w. The sources of energy available through this station are as follows : Lachine water power, present capacity 6,000 k.w., distance 5 miles; Chambly water power, 15,000 k.w., distance 17 miles; Shawinigan water power, 10,000 k.w., distance 85 miles ; steam reserve, Queen street station, 4,000 k. w., 500 feet ; steam reserve, Water street station, 1,000 k.w., 2 miles.

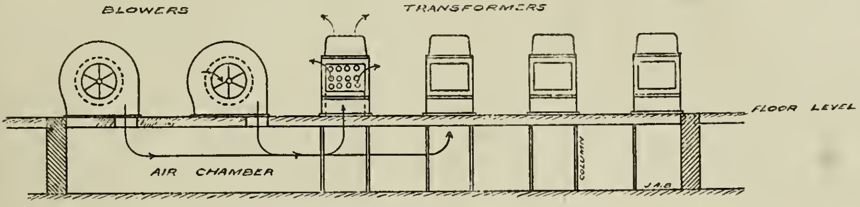


Fig. 5.—Diagram Showing Air Circulation.

In conclusion it may be stated that no expense or effort has been spared on the part of the Montreal Light, Heat and Power Company to make this installation a perfect one of its kind.

THE STEAM TURBINE.

Before the mechanical section of the Canadian Society of Civil Engineers in Montreal Prof. Homer M. Jaquays recently read an interesting paper on the steam turbine.

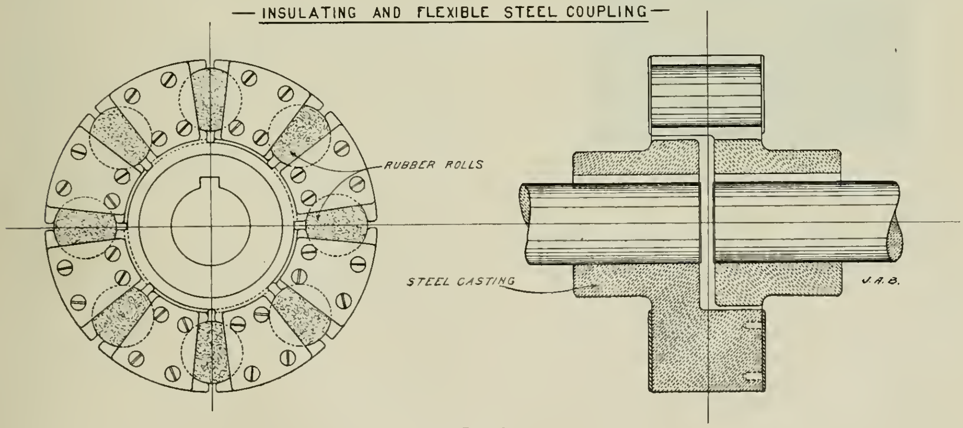


Fig. 6.

He pointed out that the turbine is the oldest type of steam engine, and has always attracted more than an ordinary amount of attention, which has considerably increased since 1884 and 1889, when patents were awarded to Hon. Charles Algernon Parsons and Dr. Gustave DeLaval, respectively. Trevithick, Pilbrow, Wilson, and a few others grasped the salient features of the modern turbine, but it needed modern workshop facilities with the attendant accuracy and attention to detail to make it a commercial success.

Previous to the last decade conservative engineers in general, undoubtedly, looked askance at rotary engines and turbines ; but it needs only a glance at the modern turbine to perceive mechanical features which must meet with approbation. The velocities dealt with when working in steam are immensely greater than can ever be experienced with water. Thus, with a head of 220 feet the velocity of the water entering the turbine could not exceed 113 feet per second. In the case of the DeLaval type, however, where the steam expands in a diverging nozzle from initial pressure to condenser pressure, it is estimated that velocities of 4,000 feet or more per second must be employed. After carefully describing the differences between the various turbines, Prof. Jaquays went on to give comparisons and results attained in experiments running over extended periods with the different types.

After the paper an interesting discussion took place which brought out the wonderful advances made in the steam turbine, so that its economy is now equal to the best reciprocating engines. It is, however, limited by the fact that its high speed renders it applicable only to fast running machinery and in the smaller sizes it is not very economical. The turbine engine, however, has many advantages, it has less weight, and hence requires the minimum of foundation ; it requires very much less space ; there is practically no vibration. Among its chief recommendations are the facts that it requires no special attention and little lubricating, and last, but not least, its extreme simplicity of parts.

Some of the aldermen of Hull, Que., favor the introduction of electric power for the operation of the waterworks plant.

Kingston capitalists have purchased the Mississippi Falls water power located about eight miles east of Mississippi Station, and will likely take steps to develop the power and transmit it to Kingston and other points. It is said that 8,000 horse power can be obtained.

THE CANADIAN WESTINGHOUSE COMPANY.

At a meeting held in Hamilton on October 10th, and presided over by Mr. George Westinghouse, the Canadian Westinghouse Company, Limited, was organized, with a capital of $2,500,000. The new company is a consolidation of all the Westinghouse interests in Canada, which heretofore had been conducted individually. It will take over all the property, patents and other interests of the succeeded companies, including the sales organization and business of Ahearn & Soper, of Ottawa.

The following board of directors have been elected: George Westinghouse, of Pittsburg; C. F. Size, of Montreal; H. H. Westinghouse, George C. Smith, Frank H. Taylor, L. A. Osborne, all of Pittsburg; Thomas Ahearn, of Ottawa; Hon. J. M. Gibson, of Hamilton; W. Y. Soper, of Ottawa; Paul J. Myler, of Hamilton.

The Executive Committee as formed will consist of the following gentlemen: H. H. Westinghouse, F. H. Taylor, L. A. Osborne, George C. Smith, and W. Y. Soper. The officers as elected are: George Westinghouse, president; H. H. Westinghouse, 1st vice-president; F. H. Taylor, 2nd vice-president; Paul J. Myler, general manager and treasurer; John H. Kerr, secretary.

MR. PAUL J. MYLER,
General Manager Canadian Westinghouse Company.

While only the ten directiors named were elected, the Board when complete will consist of fifteen members, the remaining five to be named from among the Canadian gentlemen interested.

Ground has already been broken for the new works to be built in Hamilton and the erection of the buildings will follow as fast as possible under the direction of Westinghouse, Church, Kerr & Company and Mr. F. A. Merrick, superintendent of the electrical department of the Canadian Westinghouse Company.

The Canadian Company took over the business of the Westinghouse Company on November 1st. The principal sales offices are located in the Lawlor Building, corner King and Yonge streets, Toronto, and in the Liverpool, London and Globe Building, Montreal. Mr. T. C. Frenyear, of Buffalo, has been placed at the head of the sales organization as sales manager, and is now located at the Toronto office. Mr. Henry D. Bayne has been appointed manager of the Montreal office, while Mr. T. F. Dryden will continue in charge of the Toronto district sales and will be located at the Toronto offices.

When it is considered that the Westinghouse Manufacturing Company alone have had sales in the Dominion to about $2,000,000 annually, the importance of this addition to the Canadian industry cannot be overestimated. The business in Canada has grown to such proportions that, in line with the policy of Mr. George Westinghouse to establish works in the countries served, the Canadian Company was essential to the proper care and conservation of the demands and interests of the Dominion. No doubt it will soon become one of the largest manufacturing establishments in this country.

TREATISE ON THE NERNST LAMP.

A valuable treatise on the Nernst lamp has just been compiled by Mr. A. J. Wurts, electrical engineer of the Westinghouse Company, who has developed the Nernst lamp to its present practical efficiency. It is a text book of the highest character and will prove of value and interest not only to the electrical profession but also to students of electrical science. The construction and characteristics of the Nernst lamp are explained in an able manner, and voltage charts are shown of particular interest. The following useful notes concerning the lamp are given:

(1) The heater of a Nernst lamp will be cut into circuit in a six glower lamp when four glowers are burned out, in a three glower lamp when two glowers are burned out, in a two glower lamp when two have burned out, and in a one glower lamp when its glower has burned out.

(2) The greater the number of alternations, the longer the life of the glower.

(3) It is not desirable to place a Nernst lamp inside of an outer globe. The Nernst lamp is a finished lamp in itself, and the shell or housing of a Nernst lamp will cast a shadow on the outer globe, producing an inartistic effect.

(4) The power factor of a Nernst lamp is 100% and the watt consumption is equal to the product of the volts times the amperes.

(5) A 220 volt lamp runs at the same efficiency as a 240 volt lamp, but the latter will have a correspondingly higher candle power and watt consumption.

(6) If all the distinguishing marks on two Nernst lamp bodies are removed, the size of the ballast wire will quickly determine whether the lamp belongs to the 110 volt or the 220 volt type, the smaller wire indicating the higher voltage.

(7) The voltage of a single heater tube for a 220 volt lamp is 110; the voltage of a single heater tube for a 110 volt circuit is 55.

(8) Glassware should be attached loosely to the lamp bodies, allowing for expansion and contraction.

(9) Large globes should be protected with a wire net.

Mr. Charles Copeland has purchased the electric light plant at Elmvale, Ont.

The Star of the East Gold Mining Company have purchased from the Canada Company the old Snyder Depot property, mill site and water power on the Mississippi river at foot of Lake Wassanga, Frontenac county. It is proposed to repair the dam and install an electric plant for the operation of the mine, one mile distant.

QUESTIONS AND ANSWERS

1. When measuring the power taken by an induction motor which has condensers on it, where should I connect in my instruments, between the service and the condensers, or between them and the motor?

ANS.—If you are using a wattmeter, and want to measure very accurately, and to get the power consumption of the motor only, the instrument should be wired in between the machine and the condensers. On the other hand, if you are trying to get a commercial reading, you should include the power taken by the condensers as well, when the meter should be connected into the service wires. This will give a slightly larger reading than that of the motor only, but a customer should pay for the losses in the condensers just as much as for the power consumed in the motor. If you are using an ammeter it must be put into the service wires, otherwise you will get a reading which may be very deceptive, as the current in the lines to the motor between it and the point where the condensers are tapped in, is usually considerably larger than that in the service wires.

2. Will you please explain what there is peculiar in the Meridian lamp that makes it of such a high efficiency. Why cannot all incandescent lamps be made of the same efficiency?

ANS.—The Meridian lamp is really an ordinary incandescent lamp, that is, it has a filament of the same composition as the other types, but the secret of high efficiency lies in the addition of a reflector to the upper half of the bulb. This sends all the light rays which ordinarily would go up, and thus be wasted, down into the space below the lamp. The light in this direction is thus much greater, or in other words, is of larger candle power for the same energy consumption, which constitutes high efficiency. As a further aid to the vertical distribution of the rays of light, the filament is placed so that its axis is mainly horizontal, instead of being vertical, as in the majority of the other types. All incandescent lamps are not made after this pattern because it is a patented article, and further, a large part of them are used for general illumination, that is, to throw light in all directions, whereas the Meridian sends most of it directly downwards, and over a comparaitvely limited area.

3. What kind of tie wire is best to use when putting up an aluminum line?

ANS.—Just as you use a copper tie wire for tying a copper line, it is considered desirable to use an aluminum tie if the line is of that matter. This is done bacause if you used dissimilar metals it might give rise to an electrolytic action at the points of contact, more especially if there were any salts present in the air. If the main line wires are bare, the ties would be bare also, as there is no object in going to the expense of weatherproofing them. On the other hand, if the line is weatherproof the ties should be covered in a similar way, as a bare tie would soon cut into the covering on the line wire.

4. I am interested in a company which is going to put up a three-phase transmission line about twelve miles long, the pressure being 10,000 volts. Which kind of insulator would be the best for use to use, glass or porcelain?

ANS.—It is impossible to lay down a hard and fast rule, each style having its good points. Porcelain is stronger and thus will stand heavier blows without breaking; but the glaze sometimes cracks under the action of extreme cold, and thus destroys the insulation. On the other hand, it does not so readily condense moisture on its surface, and so maintains, on the whole, somewhat better insulation in damp situations, though where there is much smoke, such as along railroads or in cities, a film of dirt soon covers any style of insulator, and thus makes them all more nearly equal. Glass has the advantage of passing more light through it, which in some situations becomes a value, as it tends to prevent cocoons and cobwebs forming in the grooves. On the whole, unless your plant presents some very special features, we do not think that you would find much difference between one type and the other—and glass is cheaper.

5. Why is there such a difference between carbons for enclosed arc lamps and those for the open type? What would happen if you used common carbons in an open arc lamp? What are cored carbons used for?

ANS.—The difference in structure is that the ordinary carbon is made of petroleum or gas retort coke, whereas those for enclosed lamps are composed principally of lamp-black. The more expensive construction is necessary because the ordinary carbon contains impurities which would blacken the enclosing globe too quickly, besides burning at a lower temperature and thus not giving so much light. Further than this, foreign matter of any kind is apt to cause flaming and hissing. Another point is that the ordinary carbon is not straight enough, nor is the diameter sufficiently uniform, to allow it to go through the gas cap on an enclosed lamp without either sticking or else letting too much air through. Cored carbons are used on alternating lamps to prevent the arc from wandering round the edge of the carbons, the current following the soft core, which is of lower resistance than the rest of the carbon. They are often used as well in direct current searchlights, where it is necessary to keep the arc as closely as possible to one definite point.

6. Does it matter in what lead you put the ammeter on a compound wound dynamo, and also the series field?

ANS.—When operating a single dynamo, it makes no difference whether the ammeter is on the positive or the negative side, but when more than one are in service they must be put in the lead opposite to the series field; if put on the same side as the latter they may not record correctly because part of the load on one machine or the other may go through the equalizer. It makes no difference whether the series field goes into the positive or negative side, the only precaution necessary being to see that if you are not running more than one machine, that the various series windings are all in the positive or all in the negative leads, otherwise there will be a short-circuit when you close the equalizer switches.

The Colonial Cement Company, of Wiarton, have just taken tenders on the installation of the necessary electrical apparatus.

CANADIAN
Electrical News
AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY
THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.

1ST VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

2ND VICE-PRESIDENT:
A. A. WRIGHT, M. P., President Electric Light & Power Co. Renfrew, Ont.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.
C. K. GREEN, Superintendent Hamilton, Grimsby and Beamsville Electric Railway, Hamilton, Ont.
CHARLES B. HUNT, Manager London Electric Co., London, Ont.
J. A. KAMMERER, Director Cataract Power Co., Hamilton.
H. O. FISK, Superintendent Peterborough Light & Power Co., Peterborough, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, CHAS. MOSELEY, - -	Toronto.
Vice-President, J. G. BAIN, - - -	Toronto.
Treasurer, A. M. WICKENS, - -	Toronto.
Registrar, W. G. BLACKGROVE, - -	Box 531, Toronto.
Solicitor, H. CARSCALLEN, - -	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Geo. Fowler, A. M. Wickens, F. W. Donaldson, J. G. Bain, W. G. Blackgrove.
HAMILTON, T. Elliott.
BRANTFORD.—A. Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

AUXILIARY EXAMINERS—F. Simmons, Kingston; T. Wensley, Ottawa; R. Fischleigh, Bowmanville; W. Oelschlager, Berlin; W. A. Matthews, St. Thomas.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, H. E. TERRY, -	Toronto, Ont.
Vice-President, J. R. UTTLEY, -	Waterloo, Ont.
Secretary, W. INGLIS, - -	Toronto, Ont.
Treasurer, J. M. DION, - -	Toronto, Ont.
Conductor, F. W. SCUTTHORPE, -	Hamilton, Ont.
Door Keeper, J OGLE,	Brantford, Ont.

British Practice.

A recent number of the Journal of the Institute of Electricla Engineers (England) contains the report of a paper and discussion on the subject of direct current motor rheostats, or starting switches as they are referred to in the article. The matter is very interesting, as showing the difference between British practice and that obtaining among us. In the first place, in addition to the absorption, or sand and porcelain embedded type, and the direct radiation or open spiral form, they have a third class, namely, that using a liquid, such as soda and water, for the resistance material. This type is practically unknown over here, except for experimental work. A point brought up was that motors of forty or fifty horse-power were considered large, and that probably either a teaser system or a double commutator machine would have to be put in to reduce the starting current. On this continent, neither these nor machines several times their size are found to be beyond the capabilities of an enlarged form of the controlling apparatus used with what we consider very moderate sized equipments. There were many advocates for totally enclosed and also for water-proof construction, forms seldom encountered here unless in outdoor or naval work. There seemed to be a difference of opinion as to the most desirable field connections, some advocating the gradual building up of the field as current was supplied to the armature, this in order to avoid shock or strain to the machine, others maintaining that it was preferable to energize the field before closing the armature circuit, this so as to reduce the starting current. One type provided an indicating lamp as a standard part of the equipment, this acting as a discharge resistance to take the inductive kick of the fields when the motor was shut down, and also as an indicator to show the speed increase of the motor as it was being started, the connections being such that the lamp received a gradually decreasing voltage as the motor speed increased. The aim and object of all our designs is to do away with everything not absolutely necessary; to that end our standard motors are quite able to withstand field kicks, nor do they need speed indicating devices when starting up. As another example of the refinements so frequently found in British products, might be cited the advocacy of a coarse pitched screw, to actuate the contact brush, giving it a slow and steady movement, also the attaching of a centrifugal governor to these parts, so that when the apparatus opened automatically it might do so without shock to the parts concerned. On the whole it would seem as if the practice over there were hedged about and hampered with safeguards and other etcetras, which to our view are totally unnecessary, though if we viewed them from the other standpoint we might find some at least not entirely unjustifiable. On the other hand, it is quite possible to make an article too good, and to surround it with too many safeguards, an appreciation of which fact may be in part the explanation of the tremendous growth of the electrical industry on this Continent.

High Speed Railroading.

It will be remembered by most of our readers that some two years ago a most elaborate system of experiments was started, under the patronage of the German Government, with the object of attaining, if it were possible, a speed of 125 miles per hour, or more, from an electrically driven vehicle. The road selected as the scene of the trials was a line running from Berlin to Zossen, and as this formed part of the far-famed German military system, it is reasonable to suppose that it was of superior construction and in good condition. Notwithstanding this, and that the experiments were carried out under the direction of the most distinguished engineers in the country, in collaboration with some of the military staff, the desired speeds were not reached owing to the failure of the track. At 80 to 90 miles per hour this began to show serious weakness, and the trials had to be stopped completely at a rate something under 100 miles per hour. The data observed, however, were most valuable and were such as to justify the prediction that the cars and trucks, with the motors and controlling devices, were capable, in the main, of fulfilling the calculations. In view of this, steps were at once taken to make the roadbed equal to the demands which would be made upon it by the speeds ultimately to be attained. To this end it was considered necessary to completely renew the line throughout and to provide the precaution of two additional guide or guard rails, one on the inside of each of the two track rails. This being somewhat beyond the financial abilities of the syndicate which had originated the tests, the government very properly undertook the work. The changes required considerable time, so that it was only during the past month that they were completed, and the tests resumed.

Commencing at about 90 miles, the rate was gradually increased until a speed of 117 miles per hour was reached. The tests then had to be discontinued, as the line was needed for some days by the military authorities, but upon their resumption the results were even more satisfactory, the enormous rate of slightly over 124 miles per hour being attained, and thus to Germany belongs the credit of the fastest moving human device so far produced, projectiles alone excepted. There are no very definite details to hand as yet, but the cable despatches apparently indicate that the car making the above runs was equipped with 13,000 volt three phase induction motors, built by Siemens & Halske. In the meantime it is interesting to note the main outline of the car with which the first trials were performed. This was equipped by the Allgemeine Elektricitats-Gesellschaft with 4 motors of a nominal aggregate rating of 1100 h.p. and a maximum of 3000 h. p. It was not considered desirable to wind these for a high potential and consequently they were made for 435 volts. They are of the direct connected type, with hollow shafts and special spring couplings, several designs of which were submitted and tested before a final selection was made. It was at first thought that some forced system of lubrication would be necessary, owing to the extremely high bearing speeds, but this introduced great complications in the shape of flexible joints in the piping, and was finally abandoned for the ordinary rinsing system, with disc oilers, which proved quite satisfactory. The transformers were carried on the car, and cooled by an air blast generated by the motion of the vehicle .The trolley line was a three phase 50 cycle system, operating at about 13,000 volts, the three wires being arranged in a vertical plane. The car was supplied with two trolleys per phase, as a precautionary measure, making six in all. They are of the bow type, with sliding contacts, set vertically, and made of aluminum, presumably to reduce the inertia of the moving parts. Many experiments were made to find a controlling device capable of handling 3,000 h.p., a problem never attacked before, and these finally resulted in the selection of the method whereby an external resistance is inserted into the secondary of the motor, a liquid being used as the conducting medium.

Up to this point the system presented no new features, but here was introduced, as a remedy for boiling and as a means of reducing weight, the extremely novel device of keeping the electrolyte constantly in motion, by a small pump, through a set of cooling coils. Further, this added greatly to the ease of control, as it was then a simple matter to vary the resistance, not by the ordinary method of raising or lowering cumbersome and heavy electrodes, but by varying the height of the liquid surrounding them. A small valve accomplished this, sending the circulation into the resistance chamber or through a by-pass at will. In view of the high speeds to be used, it was considered desirable to provide reserve braking equipments, and so, in addition to a Westinghouse air system and hand brake mechanism, provision was also made for reversing the motors very gradually, and further for exciting the fields from a storage battery, the armatures being closed through a resistance. The trucks, two in number, were finally made of the six wheel type, though as at first designed they were to be of the eight wheeled form. Various trials were made on a dummy platform which allowed the wheels to revolve while the car stood still, the motors being brought up to a speed equivalent to a car rate of 125 miles per hour. This served as some sort of a guide as to the suitability of the bearings and the strength of the materials, though many other stand trials had been made of the different parts during design and construction. It will thus be seen that the matter called for the most minute and careful investigation into many problems involving bearing speeds, centrifugal forces, wind resistances, etcetra, hitherto untouched. All these had to be overcome with the least possible material, the reduction of weight being essential, and our German friends are consequently much to be congratulated on the gratifying results which they have obtained.

Since the above was written cable despatches tell of later trials which have resulted in the still more astonishing rate of 131½ miles per hour, coupled with the statement that it was expected that even higher speeds would be attained before the trials come to an end.

ENGINEERING STUDENTS VISIT PETERBOROUGH.

The students of the School of Practical Science, Toronto, in charge of Prof. C.H.C. Wright and Prof. T.R. Rosebrugh, with President Loudon, of Toronto University, and members of the Faculty, visited Peterborough on October 24th on their annual excursion. The many important electrical and engineering works in and around Peterborough were inspected with a great deal of interest and pleasure. The hydraulic lift lock on the Trent Valley canal, which is said to be the largest of its kind in the world, was a revelation to many of the students. The electrical plants of the Otonabee Power Company and the American Cereal Company, the latter being in process of construction, were visited, also the great manufacturing establishments of the Canadian General Electric Company and the William Hamilton Manufacturing Company. In the evening a dinner was held in the Oriental Hotel, with Principal Galbraith presiding.

FIRST AIDS AND APPLIANCES.*

By J. D. M'GOWAN, M.D.

I believe this is the first time in the history of this association that any paper pertaining to relief of the injured has been read at its meetings ; and it is one of the gratifying signs of the times that the interests of others than the members of the medical profession are being awakened, not only to measures for the prevention of disease, but also for preventing, so far as it is possible to do so, some of the unfortunate results of either improper treatment or no treatment at all in cases of accident, whether of a serious or an apparently trifling character.

Owing to the prompt application of first dressings, in the late war between the United States and Spain, the records of the surgical department of the army and navy show a smaller percentage of loss of life or limb than in any previous campaign.

As all, or nearly all, of your shops are in large cities and towns where the services of a surgeon can be readily obtained, and no great amount of time need elapse from the moment of accident to the obtaining of skilled surgical aid, I will not go into an elaborate detail of all that should be done, as it is far better to do too little than too much.

If your shop is in Pennsylvania, you may have in your employ a young man who has a brother practising medicine in Iowa, and such relationship is apt to make him believe he has the medical instinct which gives him a knowledge superior to his fellows. If you have such a man about, and an accident happens, send him for a doctor.

It is well to have on hand at all shops or factories a box containing the necessary articles for the application of first aid and have a few of your intelligent foremen instructed in their use.

When an accident happens :

Do not get excited.

Send for a surgeon ; tell him briefly the nature of the injury.

Remove the injured man to a quiet, well-ventilated place, neither hot nor cold, away from the noise of the engine room and machinery, and place him in as comfortable a position as possible; lay him upon his back, with his head on a level with his body, and his limbs in a natural position.

Allow nobody near except those who are needed to care for him.

Do not let him know that his condition is serious; encourage him all you can.

If the head has been injured, it should be raised somewhat higher than the rest of the body.

Loosen his clothing at neck and waist ; if patient faints, lower his head and raise his feet.

If arm or leg is injured, it may be slightly raised and laid on a cushion ; a cushion may be made with old clothing or any soft material.

If he vomits, or tries to do so, turn his body on one side, with the chin low, so that the contents of the stomach may flow from the mouth.

If the wound is found covered by clothing, cut the clothing in the seam and remove only enough to show the wound. In case of burns, pour luke warm water over the clothing before attempting to remove it ; otherwise you are liable to pull off the charred skin and leave a large, raw surface open for infection. Cover all wounds and burns as quickly as possible.

In examining a wound wrap some antiseptic gauze around the fingers before touching it. Do not attempt to cleanse a wound ; expose it and apply some antiseptic gauze, or the contents of this little package, called "first help for wounds," and wait for the surgeon to cleanse the parts.

BLEEDING.

From the arteries, blood is bright red and comes in spurts or jets, as from a small hose. This should be immediately stopped if possible, and the best method is to apply pressure over the artery at some point nearer the heart than the point of bleeding, selecting a place where the artery is near the surface of the body. First, apply several thicknesses of gauze over the wound (having fingers wrapped in a separate piece of gauze before handling), and bind tight with roller bandage; then cover the point selected between the wound and the heart, apply pressure, using anything at hand for the purpose—a piece of rubber tubing, such as is used for gas piping, is best, a pair of suspenders, a rope or bandage; bind the parts tightly and leave them until the aid of a surgeon can be obtained.

From the veins, blood is of dark-red color and flows out or wells up freely from the wound. Apply pressure directly over wound, using wad of gauze and bandage.

When the blood oozes from the wound, apply gauze and bandage.

In case of bleeding, keep the patient in a horizontal position; if bleeding from a limb, elevate the limb; keep the patient warm. When bleeding has ceased, hot drinks may be given.

Do not leave tight bandage on a limb too long; the bandage may be loosened after fifteen minutes and reapplied with diminished pressure. In rupture of varicose veins, elevate the limb, loosen clothing, and bandage firmly below the wound, and apply a compress over the bleeding vein.

When a man faints from loss of blood, lower the head and raise the limbs ; be ready to apply compress, if bleeding starts up again.

Do not cover a wound with any dressing that is not sterilized.

Do not forget to elevate the limb.

Do not put on cobwebs, tobacco, shellac or salve.

Do not disturb blood clots.

Do not give whisky or brandy.

Do not leave a wound uncovered after the bleeding has stopped.

For internal bleeding, apply ice-cold cloths to abdomen ; lower the head slightly.

WOUNDS.

In injuries to the head, place the patient on his back, with the head resting upon a cushion covered with a clean towel.

The arm, when injured, should be brought across in front of the chest and supported by a sling.

The lower limb should be supported on a cushion or blanket.

In chest wounds, the head and shoulders should be raised by one or more pillows until patient can breathe comfortably.

In wounds of abdomen, patient should lie down with knees drawn up towards injured side ; if wound be in front, place him on his back.

After covering a wound of any kind, do not uncover it ; put on more bandages if it bleeds.

In bruises or sprains, apply hot water, as hot as can be borne; if an ankle is sprained or foot crushed, place it in a bucket of hot water, keeping the water hot by adding more hot water as required.

FRACTURES.

These may be simple or compound. A compound fracture is where there is an external wound communicating with the fracture. This may be caused by one end of the fracture bone penetrating through the skin, or by a spike or rifle ball or some other missle piercing the skin and tissues to seat the fracture.

Place the patient in a comfortable position, supporting the injured member upon a cushion of some kind, which may be made with any soft material at hand. If possible to remove the clothing without causing much pain, it is best to do so. In simple fractures this is not absolutely necessary, as a splint can be applied over the clothing, using the latter for a pad.

In compound fractures, dress the wound with the contents of the first-aid packets, or with antiseptic gauze, before applying splints.

Do not attempt to set the bone ; merely try to put the injured part in a position where it can be held securely, so as to prevent the fractured ends of the bone from rubbing together and causing pain.

SPLINTS.

The chest can be used as a splint for the arm by binding the arm to the side with a roller bandage.

The uninjured leg may be used as a splint for the injured one.

A splint must be long enough to keep the joints above and below the injury at rest.

The splint should be a little wider than the thickness of the limb.

The splint should be padded with some soft material, such as sheet wadding, cotton, etc.

If two splints, one on each side of the limb, can be applied, all the better.

Material for splints is usually easy to obtain : cigar boxes, pasteboard, laths, shingles, barrel staves, broom handles, canes, shovels, umbrellas, desk rulers, fruit baskets, etc. Any of these may be used.

Place the splint on either side of the injured limb, have the splints well padded and secure them to the limb with a roller bandage or a handkerchief; towels, suspenders, cord or straps may be used if the bandages are not at hand.

---

*Presented before the National Electric Light Association at its Twenty-Sixth Convention, held at Chicago, Ill., May 26-28, 1903.

Some one should support the limb by slipping the hands gently under it, above and below the injury, while the others are applying the splints.

In fractures of the skull, place patient on his back with head and shoulders slightly raised, and keep quiet until the surgeon arrives. If there is a scalp wound, place some antiseptic gauze over the wound.

In fractures of spine, keep patient flat on his back.

In fractures of collar bone, place pad under armpit and bandage arm to side. Patient is best on his back.

In fracture of ribs, patient should be moved as little as possible. Keep head and chest elevated ; let him lie on his back or on the uninjured side.

In fracture of thigh, apply a long splint made of board, to extend from below the foot to above the hip, first drawing the limb out to its full length, and bandaging the splint to the leg at the ankle, the knee and about the waist.

In fracture of knee-pan, place a pad in the hollow under the knee and apply a splint to the back of the leg, keeping the leg straight.

In fracture of leg below the knee, place the leg gently in a pillow and bind the pillow to the leg. If no pillow is at hand, apply a board splint (taken from a fruit basket) to either side of leg and bandage, being careful not to bandage too tightly.

If a patient is to be carried some distance, bind the injured leg to the other limb, after applying splints.

In fracture of upper arm, place a pad in the armpit and draw the elbow to the side ; bind the upper arm to the side of the chest and put the forearm in a sling.

In fracture of forearm, make a splint from a cigar box, or a piece of wood long enough to extend from the fingers to near the elbow ; place this on inner side of arm and another piece over the back of arm, and bandage.

In fracture of fingers, bind one finger to the other, after placing cardboard splint under the fractured member.

BURNS.

Burns are of three degrees :

First—Simple reddening of the skin.

Second—When blisters form.

Third—Charring of skin and ulceration.

Remove clothing carefully; cover burned surface quickly to exclude air; pour on oil. A mixture of equal parts of linseed oil and lime water forms the best and most convenient dressing for first aid, and should be kept on hand, in welt-corked bottles in every shop where a workman is liable to be burned. Pour this freely on the surface, apply sterilized gauze and saturate that, then a layer of absorbent cotton, and soak that with the oil. When the burn covers a large surface, expose and dress a small area at a time. When a man's clothing is on fire, throw him down and roll him over to extinguish the flame, or wrap him in a blanket, or some woolen material, and press the burning points from the outside.

If no oil is at hand use a warm solution of baking soda in water; or use white of egg, or powdered starch, or toilet powder.

When a burn is very extensive, and patient is in a state of shock and grave danger, if there is a bathtub available, wrap him in a sheet, clothes and all, and lower him into the bathtub, which should be filled with tepid water. He may be kept there many hours with his head above the water. This is the best method to relieve pain and to prevent the danger from shock.

Burns from ammonia, lye, etc., should be bathed freely with water, then with vinegar, and then with oil.

Burns from vitriol or other acids should be washed with water, then a solution of soda and lime water, mortar or chalk may be used ; afterwards apply the oil.

A fragment of lime in the eye should be washed out with water, and the eye bathed with a weak solution of vinegar or lemon juice.

TRANSPORTATION OF WOUNDED.

The four-handed seat is made by two persons clasping each other's wrists. Doubtless many of you have done this in your boyhood days at school.

After the hands are clasped together, the bearers stoop down behind the patient, who sits on the hands, and places one arm around the neck of each bearer.

The two-handed seat is made by two bearers clasping their hands and placing their free hands on each other's shoulders. A bearer stands on each side of the patient and passes one arm under his knees and clasps the hand of the other bearer ; the bearers then pass their arms around the back of the patient and grasp each other's shoulders.

The "pick-a-back" method may also be sometimes used. A temporary stretcher may be made by turning the sleeves of a coat inside out ; two stout poles are then passed through them and the coat is buttoned. The patient sits on this and rests against the back of the first bearer. To make a longer stretcher, treat two coats in the same way.

Two sacks may be taken ; a hole is made in each corner of the bottom, and two poles are passed through the sack and out of the holes.

A broad board or shutter may be used as a stretcher ; if used, some hay, straw, or clothing should be placed on it, and then a piece of stout cloth or sacking; the sacking is useful in taking the patient off the stretcher. Always test the stretcher before using.

Never allow stretchers to be carried on the bearers' shoulders.

Always carry patient's feet foremost, except when going up hill.

The "first-aid package," or "accident case," contains many things that are invaluable to the layman in applying relief to the injured ; there are also some articles contained therein which none but a surgeon should be permitted to touch, such as needles, sutures, etc.

If, however, the surgeon, hastily summoned, should have ommitted to bring with him all the requisites for cleansing, suturing and dressing a wound, it would be very gratifying to him to find everything ready for him in such a convenient, compact form.

One of the Chicago Edison emergency boxes, the product of Mr. W. L. Abbott's ingenious brain, is carried on each wagon. It contains a box of Edison ointment, of whose healing properties we are justly proud, a gauze bandage, a first-aid package, a hypodermic syringe, and a solution containing one-twentieth of a grain of strychnine to each barrel of syringe. The strychnine is to be used to inject under the skin of a man who receives a shock from the high-tension wires. If a doctor is near by, it is well to have the solution ready for him ; in the absence of a doctor the foreman is instructed how to use the syringe.

SHOCK.

Shock is common after serious accident, injury, burn, or from the electric current.

The symptoms or signs of shock are cool, clammy skin, vomiting and retching, weak, rapid pulse, sighing or irregular breathing, half-opened eyelids, dilate pupils, dullness of intellect, and sometimes insensibility.

Place the patient in a warm, quiet place ; after dressing wounds, wrap him in warm material and apply heat to the whole body, using hot-water bottles, water-bags, hot bricks, blankets, flannels wrung out of hot water (no heat to head), hot drinks (coffee best), spirits of ammonia diluted with water or small amount of whiskey.

Electric Shocks.—Susceptibility to shock depends upon the individual; women and children being less resistant than men. Diseases of heart and kidneys predispose to accident from electric shock. Do not lower the head of a person who has received electric shock. Artificial respiration should be kept up for hours. Massage of abdomen and left side over the heart. Heat the body as above.

Remove patient to a room in some adjacent house ; remove most of his clothing ; apply hot water bottles to body and limbs, wrap feet in hot wet cloths. Apply artificial respiration as explained below. Do not get discouraged if the patient does not show signs of life ; keep up the work for several hours. Men have been brought back to life after 10 hours of hard work, so work on patiently and constantly and you may bring back a fellow workman who is apparently dead.

Artificial respiration is produced as follows, whenever it is required : Face upwards; the hard roll of clothing beneath thorax, with shoulders slightly declining over it ; head and neck bent back to the utmost. Hands on top of head (one twist of handkerchief around the crossed wrists will keep them there) ; rip or strip clothing from waist and neck ; kneel astride patient's hips ; place your hands upon his chest, so that the ball of each thumb and little finger rests upon the inner margin of the free border of the costal cartilages, the tip of each thumb near or upon the xiphoid cartilage, the fingers fitting into the corresponding intercostal spaces ; fix your elbows firmly, making them one with your sides and hips ; then—

Pressing upwards and inwards towards the diaphragm, use your knees as a piviot, and throw your weight slowly forward two or three seconds until your face almost touches that of the patient, ending with a sharp push which helps to jerk you back to your erect kneeling position. Rest three seconds ; then repeat this bellows-blowing movement as before, continuing at a rate of from seven to ten times a minute; taking the utmost care, on the occurrence of a natural gasp, gently to aid and deepen it into a longer breath, until respiration becomes natural. When practical, have the tongue held firmly out of one corner of the mouth with thum and finger armed with a dry cotton rag. Avoid impatient vertical pushes ; the force must be upward and inward, increased gradually from zero to the maximum as the age, sex, etc., may indicate. Abandon no case as hopeless within an hour's useless effort.

The following methods may be employed : (1) Lay the patient on his back, with the shoulders elevated, draw the tongue forcibly forward, grasp the arms at the elbow and carry them upwards firmly until they nearly meet above his head, then lower them to the side, and make firm compression upon the lower part of the breast bone ; repeat this process 12 to 14 times in the minute. Or (2) turn the body gently and completely, on the side, and a little beyond, and then on the face, alternately ; repeating these measures deliberately, efficiently and perseveringly 15 times in a minute.

TELEGRAPH and TELEPHONE

NEW MANAGER OF THE G. N. W. TELEGRAPH COMPANY.

Mr. Isaac McMichael, who has succeeded Mr. H. P. Dwight as general manager of the Great North-Western Telegraph Company, was born at Brantford, Ont. At the age of sixteen years he learned telegraphy, and served four years as operator with the Montreal Telegraph Company and the Buffalo & Lake Huron Railroad Company. Recognizing the greater possibilities in the United States, he went to Ohio in July, 1860, and entered the service of the Western Union Telegraph Company as an operator. Fourteen months later Mr. McMichael went to St. Louis and entered the military telegraph service of the United States Government. He remained in that service in Missouri, Kansas, Arkansas and Indian Territory until May, 1865, when he returned to St. Louis and re-entered the service of the Western Union Telegraph Company service as operator.

MR. ISAAC MCMICHAEL,
General Manager of the G. N. W. Telegraph Company.

In 1868 Mr. McMichael was appointed as chief clerk at St. Louis, and in 1868 as chief clerk to Mr. R. C. Clowry, District Superintendent. His executive ability was further recognized in 1875 by his appointment as asssistant superintendent at St. Louis, and in July, 1881, as superintendent of the Eighth District, Western Division, at Minneapolis, in charge of the telegraph lines in the North-West which were acquired at that time by the Western Union Telegraph Company from the North-Western Telegraph Company. This position he retained up to October 31st of this year, when he assumed his dutes as manager of the G. N. W. Telegraph Company, with headquarters at Toronto.

In 1881 the territory under Mr. McMichael's charge comprised 9,076 miles of poles, 21,482 miles of wire, and 1,019 offices. During the period from that time to the present it has grown to 21,785 miles of poles, 96,070 miles of wire, and 2,533 offices. Under his iurisdiction the company's lines were extended to the Pacific Coast over the Northern Pacific Railroad in 1883 and over the Great Northern Railroad in 1893.

In Mr. McMichael the G. N. W. Telegraph Company have doubtless secured an efficient executive officer, and Canadians generally will welcome his return to this country.

GLASGOW MUNICIPAL TELEPHONE SERVICE.

Two years ago Turnbridge Wells and Glasgow were pointed to as bright examples in municipal ownership of telephone service. A few months ago the former abandoned the attempt at giving a satisfactory telephone service and sold their plant to the National Company. Now reports are coming to hand ot unsatisfactory results in Glasgow. "The Bailie," a journal published in Glasgow, in its issue of September 9th, says :

"The position of the Glasgow Corporation Telephone Department as disclosed by the published accounts for the past financial year, is proving a source of uneasiness to those ratepayers with a sound knowledge of finance. Nor have their fears been alleviated by the auditors' remarks, who, in issuing their report, make it perfectly plain that things are not as they ought to be. They point out that no depreciation has yet been provided for, nor has any sum standing at the debit ot preliminary and general expenses in capital account been written off out of revenue. In the matter of the sinking fund adequate provision has not been made, although, according to the auditors, the requirements of the Act of Parliament have apparently been complied with. Up till now, certain management expenses, amounting in the aggregate to no small sum, have not formed a charge against revenue. Despite all this the committee who run the telephone department have the temerity to present the ratepayers with a financial statement showing a balance of several thousand pounds on the right side, and claiming that if the undertaking had been a joint stock enterprise the result would have been that a dividend of five per cent. on the capital involved would have been paid. In this connection let it be pointed out that had the directors of a concern formed under the Companies Act put forward a balance sheet such as the one under review, and declared a dividend, they would have laid themselves open to much the same charges as are confronting at present Mr. Whittaker Wright, of London and Globe Finance Company fame, in which undertaking the trusting shareholders lost all they had risked.

"It is greatly to be feared that instead of getting out of the tangle the telephone department will land itself deeper into the mire, although this is a contingency apparently viewed with equanimity by those in control, who, of course, have nothing to lose. It has been said that figures can be made to prove anything, and if there is one thing the balance sheet of the corporation telephone shows, it is that the ratepayers of Glasgow have been saddled with a white elephant as matters stand at present. Were the enterprise a successs apart from its financial aspect, there mignt be some hope, but unfortunately the service is falling far short of what it ought to be, having regard to its formation at a period when the telephone business has been pretty well reduced to a fine art."

Napoleon Chamberlain, 48 years of age, a lineman in the employ of the Bell Telephone Company, died in Notre Dame Hospital, Montreal, last month, from the effect of injuries received by falling from a telephone pole at the corner of Harbor and St. Catharine streets.

ENGINEERING and MECHANICS

STEAM BOILER INSPECTION IN BRITISH COLUMBIA.

About four years ago the British Columbia Government passed an Act entitled "The Steam Boilers' Inspection Act," which provided that all steam boilers should be regularly inspected by official inspectors and that engineers operating same should first pass an examination as to qualification. In accordance with the provisions of the Act, Mr. John Peck, of New Westminster, was appointed chief inspector of boilers and machinery, and has as assistants three district inspectors, Messrs. Thomas H. Goldie, S. Baxter, and George O. Madigan.

Mr. Peck has just issued his first annual report, which covers the calendar year of 1902. This report shows the vast amount of work that has been done under the inspection service, and clearly demonstrates the wisdom of compulsory inspection of boilers.

All candidates for engineers' certificates are thoroughly tested as to their knowledge of the safety valve, water gauge, steam gauge, appliances for feeding water to the boiler, the method of keeping boilers free from corrosion and incrustation, and also as to their knowledge of adjusting the principal parts of simple engines in cases of necessity. In addition to the above requirements, candidates for first and second-class certificates are given some questions in respect to compound engines, air compressors, and other machines usually found in a large steam plant.

During the year 1902 the chief inspector received 566 applications for engineers' certificates; 359 candidates were examined; 203 applications are still on file, and 4 applicants had their fees returned, as they had not the practical qualifications required by the Act.

Part of the chief inspectors' report is printed below:

We have on our report books records of 1,229 boilers that have been inspected at some time during the last 3½ years. We have also located 470 boilers which have not yet been inspected, although the owners of a great number of these have applied for inspection. The number of complete inspections during the past year was 860, leaving 839 on which no inspection was made. 321 new boilers were inspected during last year and put into operation and 57 were taken out of service. I have reason to believe that the boilers to be installed during 1903 will be very much in excess of last year's record. If last year's figures are taken as a basis, we may estimate that there will be 1963 boilers to inspect during 1903; and if we take the 860 boilers inspected last year as an estimate of the work that can be attended to by the present staff, it will be seen that there must be a substantial increase in help, if anything like the whole of the work is to be accomplished.

I beg to direct attention to the items of inspecting and testing material for new boilers. This has resulted in condemning nearly 10% of the plates inspected. As the cost of replacing these plates usually falls on the supply houses, they are now more careful regarding quality of steel sent to British Columbia customers. Too much care cannot be exercised regarding the physical and chemical properties of the steel to be used in boiler construction. Acid and Basic Bessemer Steel is quite unfit for boilers, and so is Basic Siemens-Martin Steel if made of phosphoric pig; the latter, however, if made of good pig, is satisfactory.

Experience has shown that the cold tests of sheered plates and temper-bending tests will show up bad plates, and as these tests are simple and require no appliances, we are able to carry them out. With respect to tensile strength, elongations and reduction of area, we are obliged to rely on the steel maker's reports.

It will be noticed that 332 boilers have been repaired under the Inspector's directions. These necessitated 95 special inspections after repairs were executed, and 656 additional visits.

There have been 21 accidents to engines and boilers. The engine accidents are reported under District Inspectors' reports. The boiler accidents were the result of low water, and of burning of the plates, due to excessive scale and sediment being allowed to collect on the fire sheets. It is pleasing to note that there have been only two accidents resulting in personal injury; these are reported fully in the District Inspectors' reports.

The defects observed were 2,102, of which 156 were dangerous; this is the most serious item in the report; and I hope that as the engineers realize more and more their responsibility for a number of these defects, and strive to prevent boilers being operated at a higher pressure than is consistent with safety, that these defects will be materially reduced in future.

The summary of total defects gives a very clear idea of a part of the work which is considered most important, as it is owing to the discovery and proper repair of these defects that accidents more or less serious are prevented, the life of the plant lengthened, the cost of repairs reduced to a minimum, and the plant kept steadily in operation, instead of being suddenly shut down many times during the year to repair different defects which make themselves known by serious leakage.

I may be permitted to explain that the examinations by our inspectors are the most thorough that is possible. The boilers are emptied and cleaned inside and out, and the inspector, with his testing hammer, goes over every accessible part inside the boiler, inside the furnaces, and in cases of brick-set boilers, through all flues, and finally examines the external part of the boiler and its fittings. In this way most of the defects enumerated were found.

When boilers are being inspected for the first time, careful measurements of all parts are taken, the attachments of stays and braces are carefully noted, and sketches are made of the interior construction. The strength of each part is calculated and the maximum working pressure fixed. The boiler is then filled with water for the hydrostatic test, which is applied to one and one-half times the calculated working pressure. Contrary to the opinion of the general public, the hydrostatic test is of little valne unless conducted by an expert, and is a source of danger if applied by persons who do not understand the physical properties of the material which is being tested. There is a very general idea that if a boiler is tested to 150 lbs. and does not show serious leakage, it is perfectly safe for 100 lbs. steam pressure. While this boiler did not burst, nor the stays break, during the above test, it does not follow that some of the material may not have been permanently injured, and to such an extent that when steam pressure at 100 lbs. has been acting upon it for a short time the boiler may explode.

The press reports many boiler explosions which occur only a few days after the boilers have been tested by water pressure, and sometimes mention that in order to make sure the boilers were safe, twice the working pressure was applied during the test; and these are referred to as "mysterious explosions." The only persons to whom boiler explosions are mysterious are those who do not understand the subject. Under certain conditions, boilers will explode as surely as the force of gravity attracts a mass of matter. Both obey natural laws, and if the boiler explodes it is because the forces acting upon the material composing the structure are in excess of its strength. It is only necessary, therefore, to know the strength of the material, and the direction and magnitude of the forces acting upon it.

The force generally considered is that of the steam pressure and the strength of the material, its ultimate breaking strength; and it is on account of the consideration of these conditions only that many defects develop and many accidents occur. In addition to the force due to steam pressure, there are the forces which arise from the sudden or unequal expansions and contractions of the different parts of the structure; the stresses due to the weight of the boiler upon its supports; the stresses due to flanging and forming of the different parts during construction; the unequal distribution of stresses at rivet joints; and the extra stresses due to plasticity of the structure. Instead of the strength of the structure being taken as the ultimate breaking strength of the material, it must be taken as the elastic limit of the material, which from a great many carefully conducted tests, by various authorities, is assumed to be two-fifths of the ultimate breaking strength; when the elastic limit of material is reached, any further addition to the load produces permanent set. If this takes place in the stays, they become permanently elongated, and when pressure below that which produces permanent set acts on the structure, the flat parts, which were supposed to be held by these stays, are free to move; add this continued movement results in crystallization of the sheets, and sooner or later, in the fracture of these at the hinging point.

Take a boiler tested by a person who does not realize the importance of considering the elastic limit of the material. Allow a factor of safety of "4," and assume that the safe working pressure is 80 lbs. The owner thinks it is safe for 100 lbs., and has the hydrostatic test applied for 150 lbs. per square inch. The ultimate strength of the material would be reached when the hydrostatic pressure was 320 lbs., and it is not likely that the boiler would burst until that pressure had been reached, if it was applied gradually and carefully by pumping up. The elastic limit is two-fifths of the ultimate breaking strength, and this limit would be reached when the test pressure was up to 126 lbs., and from that on to 150 lbs. the material would stretch at the weakest part.

When the steam pressure is applied at 100 lbs., or even at 80 lbs., the parts of the boiler which originally resisted the alteration of shape have been elongated and are now of little value; the strains which should have been taken by these parts are thrown on to others, resulting in crystallization, and, sooner or later, in rupture of the parts on which this extra strain is thrown.

It will be seen from the above that if the hydrostatic test is to be of any value, calculations must first be made, and the test pressure must never exceed, or even approach very close to, the elastic limit; and during the test the different parts of the boiler must be carefully gauged and measured to see that there is no alteration in the shape of the structure.

With respect to the defects enumerated in the attached summary, I wish to call attention to some of the more important. It will be seen that safety valves have not received the consideration from many steam users and engineers that one would think the merest novice would bestow on this all-important part of the steam plant. One boiler in District "C" was found without a safety valve of any description; four safety valves were found inoperative, five have been found overloaded, and 69 defective in construction; of which 20 cases in all were considered dangerous. The defects discovered are all in the old ball and lever type of safety valve. These are being replaced by the modern pop safety valve on all boilers where alterations to safety arrangements have to be made, and only the latter type are allowed on new boilers. In this way I hope to reduce these defects to a minimum.

Under pressure gauges, 158 defective is a large item, but not so dangerous as the defects mentioned above, unless the engineer alters the safety valve to suit the pressure shown by the gauge, when the same indicates less pressure than that actually on the boiler. The fact that 48 gauges were found inoperative (as well as four safety valves) shows that there are still a number of careless engineers.

The next item of insufficient staying or bracing, 84 cases, of which 20 were considered dangerous, calls for some comment. These defects are not confined to any one particular district, but are fairly equally distributed throughout the province, and are, in almost every case, found on cheap boilers, quite a number of which have been purchased from second-hand machinery agents in United States and Eastern Canada before the Inspection Act was enforced. Some few cases have occurred where new boilers have been sent in from the United States, and one such case I will cite as an illustration. A farmer on the Delta ordered a threshing engine from an American firm, to carry 150 lbs. per square inch working pressure. He became suspicious after placing the order, and asked me to have the boiler inspected before it was taken off the car, which was done. The stays were found to be insufficient, and he wired the company to that effect. They replied "Accept engine, will make good." A few weeks ago the company's agent offered the farmer $200 to get the repairs made himself. This was refused, and the deficiency is now being made good by a British Columbia company at the American firm's expense. This is a case where one farmer was saved $200 as a direct result of the working of the Inspection Act. Many other similar cases could be mentioned, but this serves as an illustration of them all, and such cases constitute one of the reasons for the general popularity of the Inspection Act.

A case is also given in the report from District "C" of a new return tubular boiler built in the United States, having four one-inch stays supporting the segment of the head above the tubes at one end, and seven one-inch stays supporting the segment at the other end; the latter even being insufficiently stayed. This means that the four stays would be carrying a load of about 46 tons if the boiler had been worked at 100 lbs. per square inch. I am inclined to think that if 46 tons were suspended over a sidewalk by four one-inch rods, there would be a tendency in most people to walk in the street instead of passing below the weight; and yet these same people would feel perfectly safe near this boiler head, simply because they would not realize the danger in the same way as they would if they actually saw the weight suspended.

Under defective riveting I wish to call attention to a case discovered in district "A," particulars of which are given in the report from that District. This is the second case of the same nature that has been found in this District. Both boilers were built by the B.C. Iron Works, Vancouver, and the company had failed before either of the defects were discovered, so that no action against them could be taken. Men who will do such work, as well as men who will allow such work to be done, should be dealt with to the fullest extent of the law. It is fortunate that in both these cases the boilers had only been operated for a short time at a low pressure before the defects were discovered.

Under the heading "Boilers with fractured plates," 43 cases are reported, six of which were dangerous. These cases have occurred mostly from two causes, over-pressure and defective settings. Where lap-joints are used at the longitudinal seams, the part of the shell near the seams is flatter than the remainder of the circle, and when the boilers are subjected to internal pressure, the flat parts of the shell tend to assume part of a circle of the same radius as the shell itself, and a hinging action takes place at the edge of the lap, usually on the inside. It has also been found that in most cases where cracks develop in the centre circumferential seams, the boilers are not properly supported on their settings, the brackets being placed near the ends, thus throwing additional strains on this part of the boiler, due to its weight. As the lower part of a return tubular boiler is subjected to severe strains due to difference of temperature between top and bottom, care should be exercised regarding supports.

"Boilers with burned plates," 73 cases, five of which are dangerous, may be commented upon, for the reasons that these accidents might be altogether prevented by the owners and the engineers. The greatest number of these cases occurred as a result of negligence on the part of the management to have the blow-off pipes removed from back head (where they cannot be placed nearer the bottom of boiler than five or six inches, on account of the curve of the head flange) to the bottom of the shell, as requested by the inspector. The alteration requires a few feet of pipe and a screwed flange riveted to boiler shell. As these are not usually at hand when the inspection is made, the inspector sees that the boiler is properly cleaned out at that time, and leaves this change to be made at the next wash-out. Advantage is sometimes taken of the inspector's leniency, with the result that an alteration which would have cost $5 or $10 and the loss of one day has, in many cases, cost the owners from $150 to $200, with the loss of a week or more. This was reported in detail at the time, and is also mentioned in the inspector's report.

District "C" has been particularly unfortunate in this respect, having 45 cases out of a total of 73, the reason for this being the increased latitude given by the inspector, at the request of the management of the mines or mills, to keep the plants running. In some cases the defects occurred through the engineers not properly cleaning out the boilers when they were opened up for that purpose.

The cases of scale or incrustation, 214, of which 22 were dangerous, should be materially reduced if the engineers and owners of the plants would work together, and see that the boilers get proper attention, as far as cleaning out is concerned.

SUMMARY OF TOTAL WORK DONE IN 1902.

No. of drawings and specifications calculated for new boilers	114
" boiler plates inspected	55
" boiler plates rejected	5
" boilers built under inspection in B.C	64
" boilers built under inspection in Eastern Canada	24
" new boilers inspected	321
" new boilers inspected built in B.C	64
" new boilers not inspected built in Eastern Canada	44
" new boilers inspected built in United States	15
" old boilers inspected built in United States	107
" boilers imported from Eastern Canada (second hand)	1
" old boilers imported from United States (second hand)	1
" boilers unclassified	23

SUMMARY OF TOTAL WORK DONE IN 1902 (Continued).

numer of bfirst inspections	546
" inspections, external and internal	810
" internal inspections only	11
" external inspections only	119
" special inspecitons after repairs	95
" visits in addition to inspection	656
" boilers subjected to hydrostatic test	783
" boilers on which pressure was reduced at first inspection	110
" boilers unsafe without extensive repairs	32
" boilers repaired under Inspector's directions	332
" boilers considered unfit for further use	8
" accidents to engines and boilers	21
" accidents resulting in personal injury not fatal	2
" investigations	5
" inspections completed	860
Total horsepower of boilers inspected	35,806
No. of defects observed, as per summary	2,102
" defects considered dangerous	156
Boilers taken out of service	57
Inspection fees earned	$7,281.63
Inspection fees collected	$6,423.23
Miles travelled by inspectors	26,340

NATURE OF DEFECTS.

	Whole No.	Dangerous.
Boilers without safety-valves	1	1
Boilers with safety valves inoperative	4	4
Boilers with safety valves overloaded	5	2
Boilers with safety valves defective in construction	69	16
Boilers without pressure gauges	1	1
Pressure gauges inoperative	44	2
Pressure gauges defective	158	2
Cases of insufficient staying or bracing	84	20
Cases of defective stays	3	
Cases of broken rivets	23	
Cases of defective riveting	38	5
Cases of broken stays or braces	8	
Cases of loose stays or braces	72	5
Boilers damaged by low water	5	3
Defective settings.	70	7
Boilers with fractured plates	43	6
Boilers with laminated plates	17	4
Boilers with burned plates	73	5
Boilers with blistered plates	2	
Cases of sediment on fire sheets	44	2
Cases of internal corrosion	78	
Cases of scale or incrustation	214	22
Cases of internal grooving	5	
Cases of external corrosion	96	5
Cases of defective tubes	59	
Cases of defective feed water arrangement	121	
Cases of broken feed valves	1	
Serious leakage around tube ends	18	4
Serious leakage in rivet joints	88	2
Defective blow-off pipes or cocks	148	4
Defective water gauges	48	13
Broken blow-off pipes or cocks	3	3
Water columns without blow-outs	6	3
Cases of broken test cocks	11	
Connections to water columns without valves	7	7
Neutral sheets not stayed	55	
Neutral sheets improperly stayed	69	
Furnaces out of shape	2	
Boilers without fusible plugs	127	
Boilers low at front end	27	
Cases of serious leakage of fittings	40	
No. of hand-hole doors having bolts and dogs burned off	4	4
Leakage at hanger lugs	1	
Cases of battery of boilers having no check valves	1	1
Defects in engine frames (broken frame)	2	
Defects in engine cylinders (broken flanges)	1	1
Boilers without hand-holes	1	
Boilers without stop valves	22	
Cases of defective steam pipes	4	
Unclassified defects	79	2
	2,102	156

MR. JOHN PECK.

Mr. John Peck, Chief Inspector of Boilers and Machinery for British Columbia, was born in the town of Billericay, near London, in 1851, and received his education in public schools. Having a natural aptitude for machinery, he selected mechanical engineering as a profession, serving his apprenticeship with a well-known firm of London engineers. Mr. Peck emigrated to Canada in 1882 and was for a time employed by the C.P.R. in Manitoba. Returning to England in the fall of 1885 to further his technical knowledge at one of the engineering schools, he obtained the position of engineer to the local Government Board for the districts of Wandsworth and Clapham, and entered the Berbeck Institute and City and Guilds of London Institute, undergoing a four years' course of evening classes and taking no less than thirteen first-class certificates in steam and mechanical engineering, electric lighting and transmission of power, mechanical drawing and other branches.

In 1890 Mr. Peck returned to Canada and located in New Westminster where he was employed by the Reid & Currie Iron Works as foreman. When this company ceased business he was appointed liquidator, and on the reorganization of the concern became manager and part owner, eventually purchasing the entire plant and establishing the Vulcan Iron Works, which, until wiped out by fire, was a prosperous institution. In June, 1901, the British Columbia Government appointed Mr. Peck to the office of Inspector of Steam Boilers and Machinery, a position which his technical and practical knowledge enables him to fill in an able and most satisfactory manner. Mr. Peck has been a member of the Board of Trade and City Council of New Westminster, and takes a lively interest in public affairs.

MR. JOHN PECK,
Chief Inspector of Boilers and Machinery for British Columbia.

TORONTO ENGINEERS' DINNER.

Once more on Thanksgiving Eve, October 14th, the Toronto engineers and their friends "feasted" of dainty dishes, speech and song at the Walker House. For the seventeenth time the members of Toronto No. 1 appeared as the dispensers of hospitality, and on this occasion Mr. N. V. Kuhlman, the worthy president, was in the chair. Nothing was lacking in the menu to appease the appetites of the numerous guests, and everything passed off in first-class style. Letters of regret were ready from His Worship the Mayor, Ald. Oliver and City Engineer Rust.

The chairman, after a few words of welcome, asked the party to drink with him the health of the King and the Royal Family, followed by the singing of the National Anthem. Then Mr. Thomas Crawford, M.P.P., responded to the toast of "Ontario, the Banner Province." He pointed out that the banding of engineers together for mutual advancement in educational matters meant a saving of life and property. He was desirous that the engineers should receive more recognition and protection from the Government, and thought much opposition to a compulsory license law came from persons who had wrong impression of the situation. In responding to the toast of "Toronto, the Queen City," Ald. Richardson spoke encouragingly to the engineers, pointing out the important relation which the engineer and the manufacturer bore to the prosperity of the country. Mr. J. Litster, manager of the Pure Gold Manufacturing Company, replied to the toast of "Our Guests," while coupled with the toast of "Our Manufacturers" were the names of Mr. G. R. Baker, of Westman & Baker, and Mr. Thomson, of the Otis Elevator Company. The latter said that the position of the engineer was being improved by the large number of new manufacturing establishments that there were being located in Canada. Nine American firms had recently established factories in Hamilton, and he believed that in other cities more or less advancement in this direction was being made. Mr. A. M. Wickens acknowledged the toast of "Our Manufacturers." He spoke of the responsibility of the engineer's position; he must know all about elevators, plumbing, steam and electric plants, etc. The Technical School in Toronto had done much to start engineers on the right course, but he feared that its usefulness would be impaired by the proposed change of management under which the Technical school, high schools and public schools were to be governed by the same board. Mr. H. E. Terry and Mr. Charles Moseley replied to the toast of "The Executive," "Toronto No. 1" was then toasted and brought a response from the president, Mr. Kuhlman.

Under the direction of Mr. George Grant a splendid program of entertainment was furnished by Messrs. E. Harrington, H. Ruthven McDonald, R. Wilson, E. Crawford, John Alexander and Howard Fletcher. The dinner committee was composed of N. V. Kuhlman, president ; G. C. Mooring, chairman ; W. H. Johnston, secretary-treasurer ; J. G. Bain, Alex. Storer, H. E. Terry, James Bannon, A. J. Butcher, and W. L. Oathwaite.

MR. N. V. KUHLMAN.

The president of Toronto No. 1, Mr. N. V. Kuhlman, is recognized as one of the first engineers of to-day. He has always taken a deep interest in the success of the Canadian Association of Stationary Engineers and his election as president was well deserved. For sixteen years he has been superintendent of the Ontario Power & Flats Company, which supplies power to a number of manufacturing concerns located in their building at the corner of Niagara and Tecumseh streets, and which has a frontage of 240 feet on Tecumseh street and 320 feet on Niagara street. It is a five-storey brick building, with over 150,000 feet of floor space, rented to the following manufacturers: John Gilchrist, sash and door factory and planing mill, employing fifty men; Barthelmes & Company, piano action and piano keys, 125 men ; Spanner & Company, fancy wood turners, 25 men; W. Bohne & Company, piano hammer makers, 12 men ; Hammer Piano Company, manufacturers of pianos, 100 men ; Mason & Risch Piano Company, 100 men; Carlyle Manufacturing Company, furniture, 10 men; Toronto Woodworking Company, rules and variety woodwork, 12 men; United Electric Company, electrical machinery, 75 men; Fairles Milling Company, flour and cranes, 10 men; Toronto File Works, 25 men. The steam plant consists of a pair of Brown twin engines, 350 horse power, built by the Polson Iron Works, and three boilers of the same capacity, while there is now being installed one Heine safety water tube boiler of 300 horse power, which will give them a total of 650 horse power. At present the power is distributed by means of shafting and belting, but it is proposed to install an electric plant and furnish the power through motors. There are also installed in the building two large dry kilns for drying lumber, with a capacity of 150,000 feet. These kilns were designed by Mr. Kuhlman and constructed under his superintendence. They work very satisfactorily, about 50,000 feet of lumber being dried each week.

MR. N. V. KUHLMAN,
President Toronto No. 1. C. A. S. E.

Mr. Kuhlman is deeply interested in society work, being a member of St. John's Lodge A. F. & A. M., Albert Lodge I.O O.F., Canada Council, Royal Arcanum, and Fidelity Tent K.O.T.M.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

November 4th, 1903.

It is announced that Mr. W. McLea Walbank has accepted the position of first vice-president and chief engineer of the Montreal Light, Heat & Power Company. It is contemplated to give Mr. Walbank very largely the guidance of the practical part of the company's affairs, as to development of business and regulation of expenditure. The company are to be congratulated on securing Mr. Walbank's services, as his past experience should prove of great value to him in his new position. Besides, he is a Montrealer, and very popular.

Recently Mr. G. B. Burland, who was president of the Lachine Rapids Hydraulic & Land Company, entertained his co-directors and the managing director, Mr. Walbank, at dinner at the St. James' Club. The occasion was taken advantage of by the president and directors to make a presentation to Mr. Walbank of a beautiful sterling silver tea service, accompanied by an address expressing the high appreciation which the directors entertained of his services as managing director of the company.

The evening papers devoted some space to informing the public how the double-truck cars were now running on the Windsor circuit, etc. If they had used the word in the singular instead of the plural their remarks would have been nearer the mark However, the sample is appreciated, and it is hoped that this line, which is admitted to be the best paying one, will soon have more put on it and the disgraceful "sardine boxes" now equipping it relegated to the scrap heap, where they belong. By the way, this is the line which takes visitors both from the G. T. R. and C. P. R. stations up to the Windsor Hotel.

The Bell Telephone Company are working hard at their new building on Hospital street, in rear of the present main exchange. Upon completion a "central energy" switchboard will be installed. The magnitude of the work of transferring from one switchboard to the other, and yet keeping subscribers' lines in operation, will be appreciated by those acquainted with telephone data.

The war among manufacturers of electrical fittings goes merrily on. Cut, cut, cut, is the rule in Montreal. Certain articles wholesaled at 13 1-5 cents, and retailed at 13½, and so on all along the line. No protection to trade. Running expenses of the business apparently nil. A reaction with a vengeance to the schedule at reasonable figures adopted by all a year or so ago. The schedule was unique in its way, as the prices were put down low to prevent importation. Now importing is more indulged in.

The delegates to the Commercial Congress from England expressed the hope for a federal bankruptcy law in Canada. The Canadian Manufacturers' Association are agitating the question. Why not the Canadian Electrical Association also, as surely the electrical trade feel the need of such an act as much as other trades.

The annual statement of the Montreal Street Railway for the year ending September 30, 1903, has just been issued. It shows the gross receipts to have been $2,222,000 and the operating expenses $1,316,000, being an increase of $176,000 in gross earnings and $182,000 in operating expenses. The decrease in net earnings is accounted for by the fact that during the year the company had two strikes on its hands. There were carried during the year 54,500,000 passengers, as compared with 49,900,000 in 1902. Transfers issued numbered 16,700,000, as compared with 15,000,000 the previous year. The net earnings were $905,939 01, as compared with $911,032.27 last year. After providing for the percentage on earnings accrued to the city, and interest on bonds and loans, the directors declared four quarterly dividends, amounting to $600,000, and in view of the company having assumed their own fire insurance risk, placed an additional sum of $25,000 to the credit of that fund, which now amounts to $239,377.31, and $50,000 to the credit of the contingent account, leaving a surplus of $9,907.54, which was transferred to the general surplus account of the company. An amount of $54,130.18 expended during the year on special renewals was charged against the contingent account.

VAST ENGINEERING PROJECT.

One of the largest engineering projects in the world is now under consideration by the African Concessions Syndicate. The details of the undertaking will not be settled until the site has been further surveyed, an operation for which the sum of $10,000 has been allocated. The proposition is the utilization of Victoria Falls, in Rhodesia, a far greater scheme than the harnessing of the Niagara Falls. The total height of the Niagara Falls is about 160 feet, whereas at the Victoria Falls the height is more than 400 feet. Again, while the total power running to waste at Niagara is estimated at 7,000,000 h.p., the available power is put at 35,000,000 h.p. As electricity is now recognized as the most economical agency for traction, it is believed that the Rhodesian railways will afford an opening for the supply of large quantities of energy when the proposed works have been established. Various mining centres already established should also be responsible for a very considerable consumption, while the development of the iron, copper and coal industries, together with the concurrent increase of miscellaneous manufacturing industries and the growth of cities and towns, will afford further scope for the absorption of power. If a radius of 600 miles could be served from the proposed power station at Victoria Falls, the whole of the goldfields of South Africa would be included in the area, and a large proportion of its railways. In other words, the area would comprise 1,500,000 square miles, including the whole of Rhodesia, Bechuanaland, and the Transvaal, as well as the greater part of Portuguese Mozambique, German South West Africa, Portuguese West Africa, and the Congo State.

RULES FOR LINE FOREMEN.

In a very instructive paper on "Overhead Pole Line Construction and Operation for Central Stations," read at the recent convention of the Association of Edison Illuminating Companies, the authors, Messrs. A. H. Manwaring and J. T. Hutchings, submited the following general rules to be followed by line foremen :

1. No wire of smaller size than No. 6 B. & S. gauge shall be used for either primary or secondary work.

2. All alternating-current primary line wire shall be erected on porcelain insulators upon adjacent pins.

3. All arc line wire shall be erected on double petticoat glass insulators.

4. Alternating-current and arc line wires shall in no case be placed upon the same cross arm unless the pole is between.

5. All joints shall be well soldered and taped.

6. Secondary lines shall at all points be at least 18 in. from primary or arc lines unless covered with heavy porcelain tubes.

7. Fuse boxes shall be placed upon all branch circuits.

8. The main circuits shall not be fused as long as the wires are maintained of the same size as at the station.

9. Fuse boxes for branch circuits shall in all cases be fused 25 per cent. smaller than the main fuse at switchboard ; and in no case shall branch fuse boxes be fused with copper wire.

10. Fuse boxes for branch circuits shall be placed upon the first pole from the junction pole.

11. Transformers shall not be placed on the exterior of buildings, sheds or other property belonging to the

12. All poles having transformers or fuse boxes upon them shall be stepped.

13. No fuse box or transformer shall be placed upon a junction pole or lamp pole, except where absolutely necessary, in which case the office shall be notified and permission obtained.

14. Transformer poles shall in all cases have full six-pin arms.

15. In placing transformers for motors, 1 k.w. should be allowed for each horse power up to 30 h.p., except where a number of motors are installed upon one group of transformers, in which case the capacity may be reduced in accordance with the condition of load.

16. All consumers having 200 lights or over, who are not regular in their hours of burning, such as churches, lodge rooms, public halls, etc., shall be placed upon two-phase wherever possible.

17. In connecting two-wire consumers upon three-wire secondary circuits, care should be taken that the load is evenly balanced, as to location and time of burning.

18. Wherever practicable, consumers should be grouped upon one transformer, or system of transformers and secondary wires.

19. The object in grounding a secondary wire of transformers is to prevent high-tension current from reaching the secondary wires. The neutral wire of all three-wire secondary circuits must be grounded, and also one side of all two-wire secondary circuits.

20. It is of the utmost importance that the primary fuses protecting each transformer shall be of a size proportionate to the capacity of the transformer. When a transformer is fused excessively heavy, or with fuses of dissimilar sizes, one fuse only is liable to blow, thus leaving current on the defective transformer.

21. It is essential that, when a primary fuse on the transformer is blown through any cause, the secondaries should be disconnected from the transformer and the latter tested to full line voltage between the primary and secondary coils, so as to determine that there is no breakdown in the insulation between these coils.

22. All alternating-current circuits should be tested daily for grounds.

23. All series lighting circuits should be tested for grounds within ten minutes after the circuits are taken off, and for open circuits, crosses and grounds at 12.10 p.m. and 3.10 p.m., and also one hour before starting time.

SMOKE CONSUMERS.

Dr. A. W. Drysdale, of Philadelphia, recently delivered a brief address on smoke consumers before the Toronto branch of the Canadian Manufacturers' Association. Dr. Drysdale said that the only real smoke consumer was "perfect combustion," which it was impossible to get. He said that a perfectly even fire, which could only be obtained by having a thoroughly good stoker, was one of the best smoke consumers known. It was impossible to prevent smoke when forcing or cleaning a fire. Ocean steamers did away with a great deal of smoke by a process of condensing. The best method for a stoker to pursue was, when firing, to feed in front, use coke, and keep the fire renewed from the front. He said it was impossible to start a furnace without smoke, no matter what the device.

On Thanksgiving Eve the premises of the Dominion Motor & Machine Company, 231 King street east, Toronto, were damaged by fire, several automobiles being destroyed.

THE COST OF STEAM POWER PER ANNUM.

There is a deal of misunderstanding in regard to the cost of steam horse power. Almost all of the figures upon which the cost of steam horse power is based are taken from large plants producing from 1,000 to 1,500 horse power. There is no question but that in large units like these a steam horse-power can be produced from $22 to $26 per annum. This is not true, however, of smaller plants. In the last few years, says Wm. O. Weber in the Engineer, I have had occasion to make up the figures as to costs of power on a number of small plants, and as a result of those figures I would submit the following table. In this table it will be seen that, while a 1000-horse-power installation of boilers, engines, buildings, chimney, and all other accessories, costs about $60 a horse-power, the same installation for 300 horse-power costs at least double per horse-power. It has been found by these figures that the interest on the first charges should be 14 per cent., of which interest is 6 per cent., depreciation 4 per cent., repairs 2 per cent., insurance 1 per cent., and taxes 1 per cent.

The attendance varies very largely with the size of the plant. In a 1,000-horse-power plant, three men in the boiler-room during the day at $1.50 a day, and one night man at $1.50, would be only $1.85 per horse-power. One engineer at $3 per day and an assistant at $2 per day would only be $1.54 per horse-power. I have allowed, however, $3.50 for attendants, instead of $3.39, which this would amount to. On the other hand, in a 100-horse-power plant an engineer at $2.50 a day would be $7.72 per horse-power, and a fireman at $1.50 per day would be $4.62 a horse-power, amounting to a little over $12. I have, however, called the figure $12, and proportioned this attendance for the other amounts of power in a ratio which would apply to the different sizes of powers and numbers of attendants required.

The cost of oil, waste and supplies is also similarly proportioned, and the results check very closely with those found in my average practice.

Some little time ago, I averaged the figures of a number of estimates made by several different authorities, with the following results: 100 horse-power, $63; 200 horse-power, $45; 300 horse-power, $37; 400 horse-power, $32; 500 horse-power, $29; 600 horse-power, $28; 700 horse-power, $27; 800 horse-power, $26; 900 horse-power, $25; 1000 horse-power, $24; 1,500 horse-power, $22; 2,000 horse-power, $21.

These figures are undoubtedly correct for the larger horse-powers, but are too low for the smaller power, principally because they have been based on mill plants, where better types of engines prevail, and more attention is given to economical administration.

I believe, however, that my figures will more nearly respresent average conditions throughout the country. Slide valve engines of from 100 to even 300 or 400 horse power are still largely used, and as economical results cannot be obtained from them as from the Corliss type of engines, so prevalent in eastern mill practice.

COST OF ONE HORSE POWER, 10-HOUR BASIS, 308 DAYS PER ANNUM

Size of plant, h.p.	100	200	300	500	700	1.000	2,000
Cost of plant per h.p. hour	$170.0	$146.00	$126.00	$96.00	$76 00	$60.00	$56 00
Coal per h.p., per hr., lbs.	7.0	6 5	6.0	5 0	4.0	2.5	1.5
Fixed charges at 14%	$23.80	$24 40	$17.65	$13.45	$10 65	$8.40	$ 7.85
Cost of fuel at $4 per ton	$38.50	$35.70	$33.00	$27.50	$22.00	$13.75	$ 8.25
Attendance, 10th basis	$12.00	$10.00	$ 8.60	$ 6.50	$ 4.70	$ 3.50	$ 3 00
Oil, waste, supplies	$ 2.40	$ 2 00	$ 1.72	$ 1.24	$ 0.94	$ 0.70	$ 0.60
Total	$76.70	$68.10	$60.97	$48.39	$38.29	$26.35	$10.70

The City Council of Sherbrooke, Que., have accepted the tender of R. Arkley for the building of a crib dam at the Westbury Basin water power, his figure being $38,000. It is proposed to proceed with the work immediately and to call for tenders at an early date for erection of power house and installation of machinery.

ANY NEW CUSTOMER

Who sends us an ORDER this month through this advertisement will be allowed an extra 10 per cent. Does it pay to advertise ?

THE HILL ELECTRIC SWITCH CO., LIMITED
426 ST. PAUL STREET, MONTREAL

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

VOL. XIII. DECEMBER, 1903 No. 12.

THE NEW COMPRESSORS OF THE GRANBY COMPANY AT PHOENIX.

By GEO. E. COLE.

Among the recent installations of power plants in British Columbia, the new air compressors of the Granby Consolidated Mining, Smelting & Power Company at Phoenix are noteworthy, and the fact that this is one of the largest plants of its kind in the province, and most modern in both its mechanical and electrical features, are reasons sufficient, perhaps, to justify a somewhat detailed description thereof.

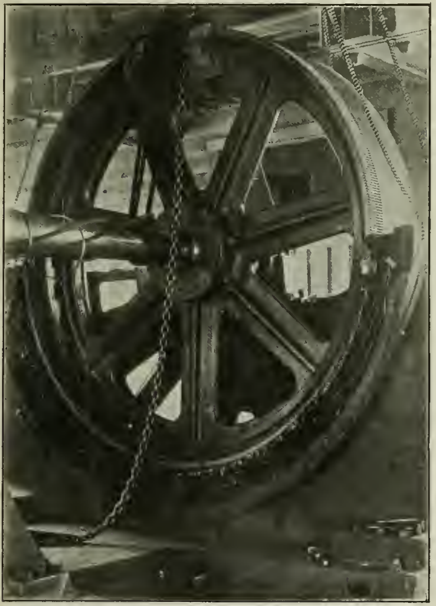


FIG. 1.—VIEW OF MOTOR SHOWING REVOLVING PART.

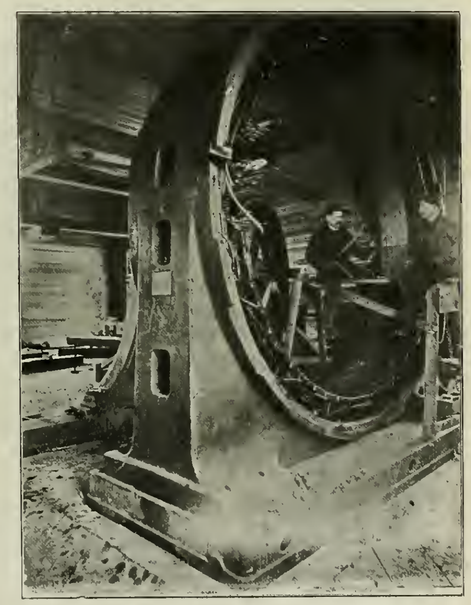


FIG. 2.—VIEW OF MOTOR SHOWING PRIMARY WINDING.

Some five years ago a 10-drill Canadian Rand air compressor was installed at the Old Ironsides No. 1 shafthouse. In 1900 another 10-drill compressor was placed in position at the Knob Hill. Before the installation of the new plant these two older compressors, hoisting engines and mine pumps were driven by steam. But the supply in the vicinity of timber for fuel purposes was rapidly becoming exhausted, with the result that steam-generated power was no longer economical. This fact, together with the large extension of operations at the mines, necessitated recently a larger plant and a change in motive power, and electricity was substituted for steam.

Power is now supplied to the Granby Company, by the Cascade Water, Light & Power Company so that, at the present time, electric motors drive the air compressors, which, in turn, supply the motive power for mine pumps and hoisting engines.

The new compressors were designed and constructed by the Canadian Rand Drill Company, of Sherbrooke, Que., and the motors were built by the Westinghouse Electric and Mfg. Company, of Pittsburg, Pa.

The superstructure of the building is of wood frame construction. The timbers used are 12x14 and the foundations of the building rest on solid rock. In appearance the exterior of the building is plain. The interior is finished in the same style, but the general arrangement of the machinery and fittings make its appearance attractive.

The general dimensions of the buildings are 120x60 ft. and the height under roof truss is 20 ft. The floors are of oiled wood, except where foundations of the

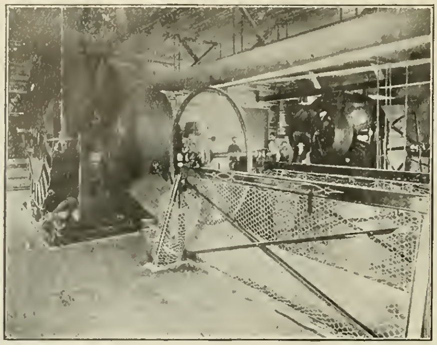


Fig. 3.—Motors in Position.

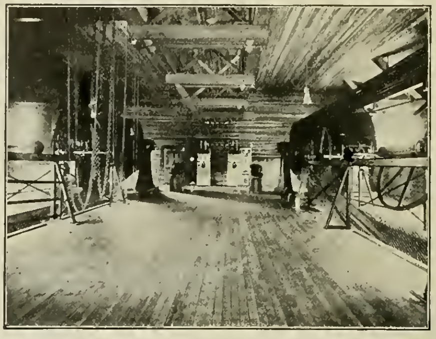


Fig. 4.—Motors, Auto-Starters and Switchboards.

compressors project about five inches above the floor level.

Both compressors and motor foundations are of concrete and rest on solid rock. In the foundations of compressors, the concrete is eleven feet deep and motors rest on foundations of 7 foot depth. The wheel pits and rope driveways are also firmly lined with concrete.

A travelling crane, capacity 20,000 pounds, operated by hand chains, spans one side of the room and travels the whole length of same. The crane runways are supported from the cross beams by heavy iron bolts. A view of the crane may be had from Fig. 4. The crane can be transferred from one side of the room to the other, and this, in a short space of time, by means of a small car which travels between the runways of the crane.

The motors, two in number, rest on 13 foot square iron bases, which are bolted to the concrete. The height of the motors above the floor is 13 feet 6 inches. (Fig. 1, a photo taken when motor was being erected, gives an idea of the size of the revolving part, which is 10 feet in diameter and 24 inches wide. Fig. 2 is a view of the primary winding before the revolving part was mounted.

Both motors are of the induction, 3-phase, Westinghouse type C. Each is wound for 2,000 volts and 7,200 alternations per minute. The speed is constant at 200 revolutions per minute, and each motor has a capacity of 700-h.p. The drive wheels are 7 feet 8 inches in diameter and 48 inches wide. They are grooved for twenty-one 1½ inch ropes. Fig. 3 shows the motors in position. That on the left is in operation, as is seen from the appearance of the rope drive and tightener.

Fig. 4, a view taken from the centre and opposite end of the room, shows the two motors, autostarters

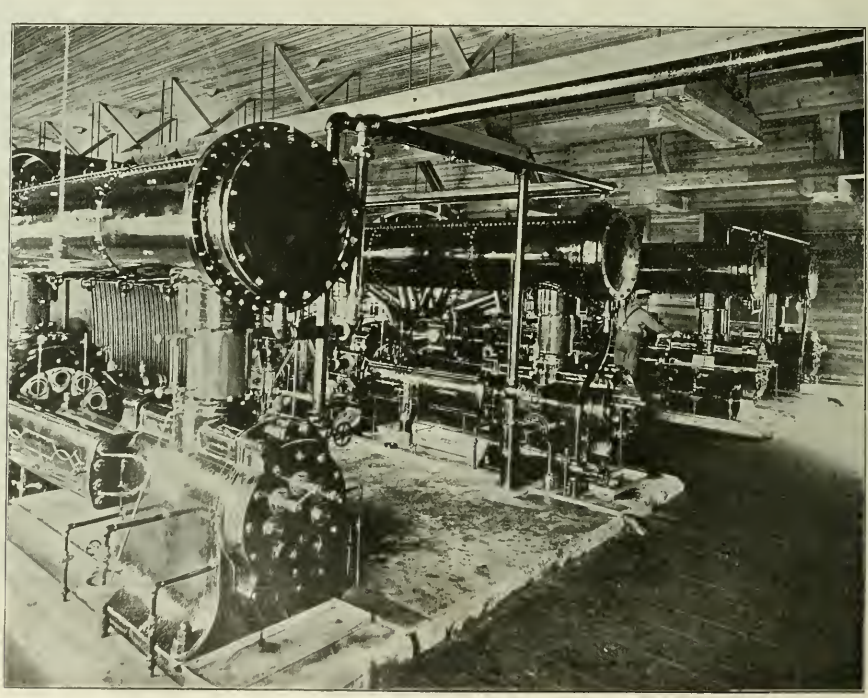


Fig. 5.—General View of Compressing Engines.

and switchboards. The well-known device of the Westinghouse Company is used in starting the motors. In connection with the controllers are two autotransformers which tend to take up any excess of current in the line, until the motor has reached its full speed. When the motor has started, the controller is then thrown on the line.

There are two switchboards, each motor having a separate panel. The third board, seen in Fig. 4, is that used for the lighting in the town. There are five instruments on each board—voltmeter, three ammeters and a watt meter. Directly above the switchboards the lightning arresters, the Westinghouse indoor type, are arranged.

The compressors are of the tandem duplex air type. The low-pressure cylinders are 28x36 inches and the high-pressure are 16x36 inches. The low-pressure cylinders are fitted with Corliss inlet valves and poppet discharge valves; the high-pressure cylinders have spring inlet valves and poppet discharge valves. Between the low and high pressure cylinders an intercooler is placed. Air is taken in to the low-pressure cylinder at atmospheric and compressed to 25 pounds pressure, at which it enters the high-pressure cylinder, when it is compressed to 100 pounds. This air is in turn discharged into an aftercooler where any heat is removed. From the aftercooler the air passes to a large receiver 16 feet long and 72 inches in diameter. Compressed air is distributed from this receiver by a main air line, which is 10 inches in diameter.

The low-pressure cylinders are lubricated from one reservoir, so arranged as to distribute the oil to both ends and also to the centre of the cylinders. Separate lubricators are used for the high-pressure cylinders Pillow blocks and all moving parts are fitted with sight-feed oilers. The crank pins have centrifugal oilers and the cross-heads a set of wipers.

Both compressors are equipped with a system of indicators whereby readings can be taken at any time showing the conditions of the valves and pistons. A gauge board at one end of the room has a high-pressure gauge, one high-grade clock, four low-pressure gauges, two revolution counters and one recording end test gauge. A set of thermometers is arranged on the low and high-pressure cylinders to indicate the effect of the cooling water in the intercoolers.

The low-pressure cylinders are water jacketed around both the cylinders and heads, but the high-pressure have jacketing around the cylinder only. The cooling water passes first through one intercooler, then through a second and finally through the cylinder jackets, which it leaves at 70 degrees Fah. A general view of the compressing engines is given in Fig. 5, in which the eight cylinders appear with the intercooler on top. The valve movements of the unloading device may be seen on the second half of the nearer compressor. Fig. 6 is a view of the engines looking towards the motors.

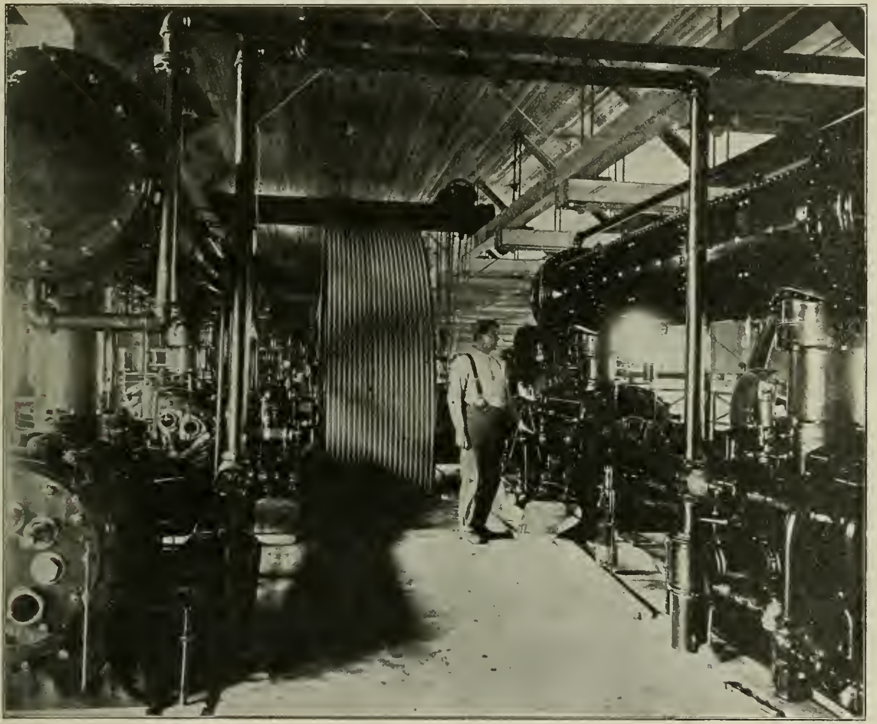


Fig. 6.—View of Engines Looking Towards the Motors.

The fly-wheels, one of which is shown in Fig. 6, are 18 feet 2 inches in diameter and 48 inches wide. Each wheel is grooved for twenty-one ropes of 1½ inch diameter. The wheels make 80 revolutions per minute and the capacity of each motor is 4,220 cubic feet of free air per minute.

Each fly-wheel is driven from the motor by an endless rope which runs from the motor drive wheel to the fly-wheel. The distance from centre of motor drive to centre of fly-wheel is 60 feet. This rope drive is arranged with an automatic take-up whereby the tension of the rope is kept constant. The track, some 40 feet in length, for this tightener, rests on an iron frame which is fastened to the floor. Views of this tightening device may be had from Figs. 5 or 6. The tension weight is taken up through the ceiling and cannot be seen from the engine room.

In trial tests, the motors were started independently and run for twelve hours. The drive ropes were then put on to connect fly-wheels and motor drives. Each compressor was then run light for twelve hours. The load was thrown on the machines and they have been running almost continuously ever since. Indicator cards have been taken from time to time showing the machinery to be in first class condition. The readings prove the compressors to be doing all the work the makers claim for them. The motors are doing their work in the same highly efficient style.

CANADIAN ELECTRICAL ASSOCIATION.

A meeting of the executive committee of the Association was held in Toronto on Nov. 26th.

The secretary reported receipt of a cheque for $99.83 from the treasurer of the Local Committee, being surplus on hand from last convention. A vote of thanks was passed to the committee, and the suggestion approved that the money be devoted to entertainment purposes at next convention.

Messrs. R. G. Black, J. A. Kammerer, A. B. Smith, the President and Secretary were appointed a committee to procure suitable papers for next convention.

Mr. A.A. Dion, of Ottawa, was appointed editor of the Question Box, first introduced at the Toronto convention, and the funds necessary for the efficient prosecution of his work were voted.

Considerable discussion took place with regard to means whereby the usefulness of the Association might be increased. A number of suggestions were made, some of which will doubtless be acted upon. It was felt that the Question Box would prove a very valuable feature, and that the correspondence in connection therewith should be the means of bringing the members into closer contact, and awaken a greater interest in the organization. The members will also be asked to suggest means whereby the value of the Association to all its members may be increased.

THE NEWMARKET BOILER EXPLOSION.

The boiler explosion in the factory of William Cane & Sons at Newmarket, Ont., on November 18th was one of the most regrettable incidents that has occurred for a long time. The boiler which gave way was of 100 horse power and one of a battery of four. The centre of the large building was completely wrecked, the force of the exploding boiler being tremendous. Two firemen, name Frank Burch and Joh Agnew, were killed instantaneously, while nine other persons were more or less injured.

The evidence given at the coroner's inquest has not thrown much light on the cause of the explosion. It has been shown that no charge of negligence could be laid against those in charge of the boilers. The boilers had been regularly inspected by the Boiler Inspection & Insurance Company, the last inspection being on September 9. On that date the boilers were found in first-class condition. It is believed that the initial rupture in the boiler took place under one of the longitudinal seams of the middle section, and it is pointed out that no test could reveal a defect there. An examination of the plates and tubes showed no indications that the water was low in the boiler at the time of the explosion. From an accurate measurement of a portion of the plate near the break with a micrometer it proved to be above the standard thickness of boiler plates.

The coroner's inquest has not yet been concluded.

ELECTRIC POWER DEVELOPMENT FOR CALGARY.

The city of Calgary, Alberta, has under consideration an extensive water power development, a report upon which has been made by Mr. Roderick J. Parke, consulting electrical engineer, of Toronto. The power is to be obtained from the Kananaskis Falls, situated 54 miles west of Calgary and one-quarter of a mile north of the C.P.R. tracks. These falls are in the Bow river at its junction with the Kananaskis river. The available head is from 45 to 60 feet. At the former head the maximum amount of power constantly available is estimated at 15,300 h. p., and at the 60 foot head 24,000 h. p. It is estimated that the cost of plant to develop the full capacity under 60-foot head, with double transmission line, etc., would be $890,000. At present it is proposed to develop the full capacity at 45-foot head, but to render available at Calgary about 1,700 h. p., at an approximate cost of $260,000. The distribution is to be 40,000 volts, three-phase, 60 cycles.

The object of the development is to provide the necessary electric energy for street arc lighting, incandescent lighting, waterworks pumping and commercial power, and when the population shall warrant, for the operation of the electric railway.

The contract with the Calgary Water Power Company, Limited, expired on September 1st, 1899. It is understood that since that time the town has been working on a monthly contract basis, paying $6.50 per month for arc lamps of 1,200 c. p. for street lighting, all night service, on moonlight schedule. The price of Crow's Nest steam coal is $5.50 per ton in bins at Calgary.

The report of Mr. Parke will be considered at an early meeting of the city council, and it is expected that a by-law will be submitted to the ratepayers some time this winter to authorize the expenditure, and if carried the work will likely be commenced with as little delay as possible.

Calgary is a progressive city and has grown rapidly within recent years. The assessment of property in 1887 was $1,217,154; in 1902 it had increased to $2,380,825, while last year there was a remarkable increase, the assessment being $3,221,549. The indebtedness of the city is general debentures $288.500, and local improvement debentures $91,000. The value of real estate and buildings owned by the city is $90,000, the original cost of which was $49,675.

A project is now on foot at Brandon, Man., to harness the waters of the Assiniboine river and utilize the power for lighting and manufacturing purposes. The Government will be prevailed upon to declare the river an unnavigable stream from Brandon upwards.

POWER DEVELOPMENT AT KAKABEKA FALLS.

By F. E. Trautman.

All mention of the industrial development of the town of Fort William, Ont., naturally brings forward the question of the development of the water power at Kakabeka Falls. It seems to be centred in the minds of all who think of the location of any manufacturing at this point that the power must be first considered.

Twenty miles above the town of Fort William the waters of the Kaministikwia river plunge over a precipice 125 feet high known as the Kakabeka Falls. To adequately understand the amount of power contained in the river it will be well for readers of the Electrical News to know that the Kaministikwia river carries to Lake Superior the water from a water shed as large as the territory embraced in a line drawn from Lake Erie to Georgian Bay and thence westward to the Detroit river. It is the outlet of Shebandowan and Dog lakes, both bodies of water of enormous size.

Five miles from its mouth the Kaministikwia river is twenty feet deep and four hundred feet wide. These factors will show that the volume of water flowing over the falls is no inconsiderable quantity.

Kakabeka Falls, Near Fort William, Ont.

The first move that was made to bring the power of the falls to the town was in 1896, when E. S. Jenison, an engineer of Chicago, made surveys of the country and estimated that the water of the river, if properly harnessed, would produce sixty thousand horse power of electrical energy. Mr. Jenison went to the Ontario Legislature and secured the right for development of the water power of the Kaministikwia river and the right to expropriate lands in the vicinity that he might need for purposes of development. In 1898 Mr. Jenison, by a vote of the ratepayers, secured a contract to furnish water and power to the town, the price to be $10,000 per year. Mr. Jenison's scheme was to divert sufficient water from the river above the falls and from the small lakes and tributary streams to furnish water for domestic use to be supplied direct into the town and such power as might be needed for electric lighting and other commercial and manufacturing uses. The water was to be brought down in a canal to a point outside the town limits and there contained in a reservoir. Water for domestic use to be supplied direct into the mains of the town and enough head secured at the reservoir to drive dynamos for electrical energy.

The scheme of Mr. Jenison was never carried out, as his contract with the town lapsed and was not renewed. During the years that intervened between the time that Mr. Jenison first projected the development of the power and the consummation of the contract with the town, there were cases at law between himself and the company known as the Kakabeka Falls, Land and Electric Company. This latter company owns the falls proper, as the rights of Mr. Jenison did not cover the water actually flowing over the falls and the land on either side. Finally the atmosphere was cleared of lawsuits and Mr. Jenison again came forward with a proposition to the town, but it did not reach maturity and the Ontario legislature of 1902 took away the rights of Mr. Jenison to the water power and transferred them to the town of Fort William.

The town was now in a position to deal with capitalists and a bargain was made with the Anglo-American Power Company, which company had been formed to take over the rights of Mr. Jenison. An agreement was entered into between the company and the town, but was rejected by the Legislature, so that the spring of 1903 saw all power development schemes vanished, the town in possession of the right to develop the rapids above the falls but not in a position to do the work as a municipality. The Kakabeka Falls, Land and Electric Company is in reality the Clergue people of Sault Ste. Marie fame. In 1886 the land on both sides of the river at the falls was acquired by E. V. Douglass, of Philadelphia, for a long time president of the Clergue companies. It now seemed to be up to Mr. Clergue to make a move and during the past summer he came to the town with a proposition, asking the right to deliver power in the town. This has been granted but no further move has been made by Mr. Clergue. The two companies that fought so long have merged their interests and the town has agreed to relinquish its rights to the power provided the companies will proceed with development. The canal idea of Mr. Jenison has been abandoned and the development will be made at the falls and the energy transmitted to the town. The company has agreed to furnish the town with power at $18 per horse power per annum in return for the use of the streets.

It will be seen that in every move made for the development of this splendid water power the town of Fort William has been ready to join heartily, the main fact ever being before the people that development is what is needed, by whom the people are not concerned. The latest move was made by Mr. Clergue. Just who will make the next is not now known.

An advertisement in the Electrical News brings results.

CANADIAN

Electrical News

AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO.
of Toronto, Limited,
HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, – – CANADA.
Telephone Main 2362.

BRANCH OFFICES:
Imperial Building, Montreal.
Bell Telephone 2299.
22 Great St. Helen's, London, E. C.

ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in delivery of the paper.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

OFFICERS:

PRESIDENT:
J. J. WRIGHT, Manager Toronto Electric Light Company, Toronto.

1ST VICE-PRESIDENT:
K. B. THORNTON, Montreal Light, Heat and Power Co., Montreal, Que.

2ND VICE-PRESIDENT:
A. A. WRIGHT, M. P., President Electric Light & Power Co. Renfrew, Ont.

SECRETARY-TREASURER:
C. H. MORTIMER, ELECTRICAL NEWS, Toronto.

EXECUTIVE COMMITTEE:
JOHN YULE, Manager Guelph Light & Power Co., Guelph, Ont.
A. B. SMITH, Superintendent G. N. W. Telegraph Co., Toronto
P. G. GOSSLER, General Superintendent and Electrical Engineer, Montreal Light, Heat and Power Co., Montreal.
A. A. DION, Superintendent Ottawa Electric Co., Ottawa, Ont.
GORDON HENDERSON, Supt. Cataract Power Co., Hamilton, Ont.
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.
C. K. GREEN, Superintendent Hamilton, Grimsby and Beamsville Electric Railway, Hamilton, Ont
CHARLES B. HUNT, Manager London Electric Co., London, Ont.
J. A. KAMMERER, Director Cataract Power Co., Hamilton.
H. O. FISK, Superintendent Peterborough Light & Power Co., Peterborough, Ont.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

BOARD OF EXAMINERS.

President, CHAS. MOSELEY, - -	Toronto.
Vice-President, J. G. BAIN, - - -	Toronto.
Treasurer, A. M. WICKENS, - -	Toronto.
Registrar, W. G. BLACKGROVE, - -	Box 531, Toronto.
Solicitor, H. CARSCALLEN, - -	Hamilton.

TORONTO—A. E. Edkins, Chas. Moseley, O. P. St. John, Gen. Fowler, A. M. Wickens, F. W. Donaldson, J. G. Bain, W. G. Blackgrove.
HAMILTON, T. Elliott.
BRANTFORD. A Ames.
LONDON—F. G. Mitchell.
BROCKVILLE—W. F. Chapman.

AUXILIARY EXAMINERS—F. Simmons, Kingston; T. Wensley, Ottawa; R. Fischleigh, Bowmanville; W. Oelschlager, Berlin; W. A. Matthews, St. Thomas.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

President, H. E. TERRY, -	Toronto, Ont.
Vice-President, J. R. UTTLEY,	Waterloo, Ont.
Secretary, W INGLIS, - -	Toronto, Ont.
Treasurer, J. M. DION, - -	Toronto, Ont.
Conductor, F. W. SCUTTHORPE, -	Hamilton, Ont.
Door Keeper, J OGLE,	Brantford, Ont.

Wireless Telegraphy.

Wonder is being expressed at the dropping out of sight of Mr. Marconi and his trans-Atlantic and trans-Continental wireless telegraph projects. A year ago the chief topic of discussion in and out of the press was Mr. Marconi and his alleged wonderful discovery. For months past we have heard little about the man or his projects. Is this silence ominous of work being quietly done by the inventor towards the perfecting of his system for commercial use at an early date? Or does it mean that unlooked for and perhaps insurmountable difficulties have been encountered?

British vs. American Methods.

"We turn out thirty five machines a day and sell in Great Britain ten thousand machines a year," remarked the representive of a large United States manufacturing concern the other day. When the writer began to catechise him with the object of learning what induced the Britishers to pass by the home manufacturer in favor of the foreigner, he was told that it was not because of the advantage of cheapness, as the price asked for the machines made in the States was as high as that of the British made machines. The American manufacturer's advantage was said to principally lie in two things:— freedom from everything in the form of red tape in his manner of doing business and greater perfection in shop methods in the direction of cheapening production. The American manufacturer has been driven by the high price of labor to devote much thought to means of accomplishing as much as possible by means of machinery, thereby reducing human instrumentality to a minimum. As a result it is claimed that cost of production has been so reduced as to far more than offset the advantage of cheap labor enjoyed by the British manufacturer. The fact that in an American manufacturing establishment six weeks were spent on the drawings of a machine which sells at $30, with the object of devising means whereby a flange might be placed on the end instead of on the side, thus enabling the parts to be put through without re-setting the planers, will serve to illustrate the care exercised in the drawing office. In this case no one will question the wisdom of the exenditure of $150 to discover means of effecting a saving for all time in the manufacture of even a low priced machine, the production of which, however, runs into thousands.

Trolley Catchers.

Almost every day sees some device or other brought forward to minimize time or to lessen cost, and of these one which promises to come into extended use is the trolley catcher for street cars. Anybody who has stood at a city corner and watched a pole get loose among the overhead work will realize the large possibilities of a lovely tangle which it offers. No wonder that the conductor leaves change unmade and fares half paid and hustles for his trolley rope. Almost a worse wreck is the result of a trolley run off when the car is making time on a free stretch of track. The first machines brought out to overcome this difficulty were but partially effective, in that they did not act until the pole and wheel had risen some fifteen inches or so above the wire. While this, of course, was a great improvement over allowing it to rise to the full extent of the spring and pole,it still allowed it to project enough to present quite large possibilities of trouble. The natural step after these devices had showed that there was a field for such an instrument was to design apparatus which not only would prevent the trolley wheel and pole from rising but a few inches above the wire, but which would go farther and pull them down below it. The result of these efforts has been the placing on the market of several machines which accomplish this result, and thus leave the conductor perfectly free at all times to attend to his passengers. Not only this, as it is perfectly obvious that he cannot at all times be looking after his pole, it prevents damage from run offs at unexpected points, which must occasionally occur on even the best of systems. Most of the designs now on the market are reset, after the machine has pulled the trolley down, by hand, but at least one type uses compressed air for this purpose. They are a comparatively cheap form of insurance against not only the actual damage to the overhead equipment and the rolling stock, but, what in some cases is almost worse, interruptions to the schedule, which will doubtless lead many managers to include them as part of their standard car equipment.

Niagara Falls Power. The name of Niagara Falls is world wide not only for its scenic properties, but also as being the seat of the largest electrical and hydraulic power developments known to-day. These up to the present are practically all on the United States side of the river, but those under way and projected on the Canadian side will, when completely developed, amount to a much greater total. There are at present three companies which have been granted franchises, the Canadian Niagara Power Company, the Ontario Power Company, and the Toronto and Niagara Power Company, all of which are now actively engaged on the work of getting their respective installations built and in order. The Canadian Niagara Power Company is adopting the same plant design as that used by the Niagara Falls Power Company on the New York side, namely, vertical generators and turbines, with a wheel pit and a tunnel tail race. The charter allows a total development of 100,000 horse power. The units will be 7,500 k.w. three phase, 12,000 volts, and are being manufactured by the General Electric Company. It will thus be seen that they are just twice the size of those across the river, and that they further differ in voltage and number of phases, the first installation being 3,750 k.w., 2,200 volts, and two phase. The capital interested in the two companies is virtually the same. The Ontario Power Company, on the other hand, are adopting a somewhat different plan, in that their power house will be down at the river bank, the water reaching it through steel penstocks and flumes. This means that the wheels and generators, the latter of which will be of Westinghouse manufacture, will both be horizontal. Their franchise allows a development not exceeding 150,000 horse power. The last company to enter the field, the Toronto and Niagara, is composed mainly of Toronto interests, who are also identified with the electric lighting and railway companies in that city. They will use the submerged wheel pit form of construction, similar to that of the Canadian Niagara Power Company, with a tunnel tail race emptying under the Horseshoe falls. The power house will be on the normal Park level, which means vertical wheels and generators. The franchise allows a total installation of 125,000 horse power. The units will be about 8,000 k.w. three phase, 12,000 volts, and will be of General Electric design. It will be seen from the foregoing that, when everything on the Canadian side has been developed to the limits of the present charters, there will be some 375,000 horse power available. The capacity which the Niagara Falls Power Company, the largest on the American side, will have developed in the near future is but slightly over 100,000 horse power.

Single Phase Traction. We print elsewhere in this issue a letter from the United States consul at Berlin, Germany, commenting upon a car equipped with an experimental set of single phase motors, and which, according to the information he gives, has proved an entire success. Another somewhat more detailed account has come to our notice, in which it is stated that the motor possesses a large air gap, notwithstanding which the power factor is extremely good, that it has an extremely large starting torque, behaving much as a series wound direct current machine, and that speed regulation is accomplished without the use of rheostats. If the claims made for the apparatus are borne out by experience the designers and builders have at last solved a problem which has been worked on for many years by several of the most eminent electrical firms, both on this continent and in Europe.

The main advantage of an alternating current motor is that it allows the transmission of power at a high potential, possible only with alternating current generators, owing to the absence of commutators, and the consequent decrease in the cost of copper, and uses that power without the necessity of installing revolving apparatus, such as the rotary converter or motor generator set. These equipments, necessary adjuncts of an alternating transmission and direct current motors, are not only costly to install but annually require a large outlay for maintenance and operation. It may, of course, be necessary in an alternating current motor system to install static transformers, depending on whether or no the motors can be wound to receive the line potential direct, but even if necessary they are much less costly than rotary apparatus, and require but a fraction of the attention. Another most desirable feature of the alternating motor is the elimination of the commutator, a most fertile source of repair bills, besides limiting the potential at which motors can be successfully operated, of at any rate the direct current type, to about 600 volts, which is practically universal practice to-day.

The main point which has hitherto retarded the alternating motor in its application to traction work is that both the synchronous and induction types, multiphase or single phase, are essentially constant speed machines, like the direct current shunt wound motor. Thus they do not possess that great characteristic of the series direct current machine which makes it so eminently suitable for traction work, namely, varying field strength with varying loads, and the consequent large increase in torque for but a small increase in current. In fact, both single phase and multiphase synchronous and single phase induction motors are notoriously deficient in starting torque, a point in which the direct current series motor, as constructed to-day, excels. Further, traction work, which is a most exacting service, requires for mechanical reasons a machine with considerably more air gap than is usual in stationary alternating induction motor work. This means, unless otherwise compensated for, a most difficult problem, that there is going to be a considerable decrease in the power factor, with an accompanying increase in the heating and losses in all the apparatus concerned, generators, motors and transformers, besides which the line drops will be heavier.

On the other hand, the single phase series motor, equipped with a commutator similarly to direct current apparatus, possesses starting torque and other desirable characteristics to practically the same extent as the latter, while still allowing the elimination of the rotary converter equipment. It is true that the retaining of the commutator is far from being a desirable feature, but it is stated that, in the Westinghouse motor of this type, now being built for the Baltimore and Annapolis road, the commutation is fully equal to that of the best direct current apparatus on the market to-day. We are not informed as to the specific type of machine referred to in Mr. Mason's letter, but presumably, if a commutator has been employed, satisfactory means have been found to overcome sparking. In addition to the points mentioned in the foregoing, the single phase machine has the additional advantage over any of the multiphase types of requiring but one trolley wire, the rails being used as a return. This removes the difficulty of adjacent trolley wires with a high potential between them, and simplifies the problem of current collecting devices. Besides this, the wiring and controlling apparatus is somewhat more simple for single than for multiphase work.

It will thus be seen that a single phase railway motor, possessing the necessary characteristics, is a most desirable piece of apparatus, and one which will find awaiting it an enormous field, not only ready but anxious to be exploited.

MEETING OF THE ELECTRICAL SECTION.

The recently formed Montreal Electrical Section of the Canadian Society of Civil Engineers held an interesting meeting in their rooms on November 19th. Dr. R. B. Owens, President of the Section, was in the chair, and there were present about 125 members and others interested.

The first paper was read by Mr. Paul M. Lincoln, of Pittsburg, Pa., late electrical engineer for the Niagara Falls Power Company, the subject being a comparison between the application of A. C. and D. C. currents to electric railways, with special application to the single phase system used by the Westinghouse Electric & Manufacturing Company on the Washington, Baltimore & Annapolis Railway System.

The paper was very interesting, giving very complete date as to the relative costs both of installation and operation, and also a complete description of the method used and the apparatus needed in a single phase railway system.

The second paper was read by Mr. A. H. Armstrong, of Schenectady, N. Y., and was a comparison between the advantages of electricity and steam in the operation of trunk line railroads. The paper compiled in a very concise way by means of diagrams an amazing amount of data and showed very clearly what economy could be expected by the application of electricity to heavy train loads under various conditions.

Prefessor L. A. Herdt's paper having been printed, was taken as read, and was descriptive af some European railroads now employing, with more or less success, the alternating current.

The papers showed what an immense amount of time and thought had been given to the subject by the leading manufacturers of this country, and placed things in such a light as to show how important it is for new companies to consider carefully the advantages of the new systems and their successes already achieved, before deciding on how their roads will be equipped. The discussion was interesting and general. Many questions of interest were asked and answered; and the general feeling of the meeting seemed to be that the evening had been a profitable one, especially as throwing considerable light on some of the most important questions of the day.

For subsequent meetings papers on the following subjects are promised : January 7, "The Relative Cost of Producing Power by Steam and by Water under Different Conditions;" February 11, "Recent Developments in Electric Illumination;" March 18, The Use of Electricity on Canals;" April 17, Power Station Design and Operation as Affected by Recent Adances in the Design of Turbo-Electric Machinery." Mr. W. A. Duff, of the Canadian Westinghouse Company, is secretary of the Electrical Section.

IMPROVEMENTS TO STREET RAILWAY PLANT.

The Toronto Street Railway Company are making some important improvements and additions to their power house for the purpose of providing increased power. They have recently installed two new Babcock and Wilcox boilers of a rated capacity of 520 h.p. each working under a steam pressure of 160 pounds. Two more boilers of same type and capacity are now being installed, and arrangements have been made to install four more without delay. When the proposed additions to the boiler plant are completed the company will have a total boiler capacity of 9,860 horse power, capable of carrying an overload of filty per cent. The company are also installing two Laurie cross-compound horizontal Corliss engines of 1,600 h. p. each, direct connected to two 850 k.w. C.G.E. generators. They are remodelling the switchboard and spending about $80,000 on new feed wires.

In a new building 70x130 feet a storage battery plant to help out during the hours of heavy traffic is being installed. It consists of 276 cells, of the Chloride Accumulator type, of 3,000 ampere hours capacity, and is being installed by the Canadian General Electric Company, Canadian representatives of the Electric Storage Battery Company, of Philadelphia. In the installation of this battery and other improvements in contemplation, the company hav in view the utilization of Niagara power upon the completion of the works of the Toronto-Niagara Power Company.

TORONTO ELECTRICAL ENGINEERS.

The Toronto branch of the American Institute of Electrical Engineers have held several interesting meetings, at which papers were presented and discussed. On Friday evening, December 11th, Mr. James Kynoch, chief engineer of the Canadian General Electric Company, will deliver an address on the Soulanges Canal

The meetings are held in the Engineers' club rooms, 96 King Street West, on the second Friday in each month. The president of the Toronto branch is Mr. J. A. Kammerer and the secretary Mr. R. T. Mackeen.

ELECTRIC LIGHT INSPECTION.

The Inland Revenue Department of Canada have issued a report covering the inspection of electric light during the year ended June 30, 1903. The fees for the inspection of meters were $19,739.75, as compared with $16,373.75 for the preceding year. For registration of companies there was received $4,155, making a total revenue of $23,894.75. The expenses of inspection were $8,005.74. The sum of $1,939.05 was expended on standard instruments, leaving a net revenue of $13,454.96. It will thus be seen that notwithstanding the reduction in the annual registration fees which was made on July 1, 1902, the service is self-sustaining.

There were presented for inspection 16,085 meters, 15,933 of which were accepted as coming within the error tolerated by law; 124 were rejected, and 28 were verified after first rejection. The details follow:

DISTRICTS.	Number Presented.	Verified as coming within the error tolerated by law.			Rejected.			Verified after First Rejection.		
		Correct.	Fast.	Slow.	Unsound.	Fast.	Slow.	Correct.	Fast.	Slow.
Belleville	341	151	83	107	....	....	...	....	....	....
Hamilton	663	229	200	234	....	....	....	....	....	....
London	808	246	241	312	....	1	....	....	1	7
Ottawa	3,854	223	428	3,185	15	1	2	....	....	....
Toronto	1,943	432	729	735	....	16	31	....	...	....
Montreal	3,678	2,219	1,018	400	1	21	3	3	13	....
Quebec	969	306	610	53	....	...	....	....	....	....
Sherbrooke	148	44	36	63	....	....	5	....	....	....
St. Hyacinthe	212	211	.....	.....	1	....	....	....	....	....
Three Rivers	60	25	13	22	....	....	....	....	....	....
St. John	673	243	1.8	249	....	3	....	..	....	....
Halifax	727	568	75	57	1	17	5	4	....	....
Charlottetown	86	19	25	41	....	1	..	...		....
Winnipeg	633	333	75	225	....	....	....	.. .	....	....
Vancouver	1,105	89	16	1,000	....	...	...	....	....	....
Victoria	185	60	45	80	....	...	....	....	....	....
Totals	16,085	5,398	3,772	6,762	18	60	46	7	14	7

There were registered under the Electric Light Inspection Act during the year 324 companies, an increase of 9 companies over the previous year. Estimating that one arc lamp is equal to ten incandescents, there were in use on June 30, 1903, the inquivalent to 1,350,283 incandescents, an increase over the previous year of 236,487 incandescents.

SOME INTERESTING TESTS.

At the up-town plant of the McClary Manufacturing Conpany, London, Ont., some interesting tests are being conducted by Mr. R. J. Parke, of Toronto, to ascertain whether the wast heat from the enamelling ovens can be utilized to generate steam to operate the factory. The temperature of escaping gases is about 2,000 degrees Fahrenheit, and it is believed that it will be found possible to employ the waste energy for the purpose stated. Should the results of the tests prove satisfactory; the necessary boilers will be installed.

In this connection it may be stated that the McClary Manufacturing Company have just completed the erection of new works costing $250,000, with an independent electric power plant which cost $35,000. The location is on the Thames river, about one and one-half miles east of the main works in the city of London. The electric plant was designed and installed under the supervision of Mr. Parke, and it is claimed that the power house as a whole is one of the most modern and complete independent stations in Canada. In a later issue it is hoped to present a full description.

AGETYLENE GAS EXPLOSIONS.

Two explosions of acetylene gas machines, with serious results, occurred during the past month. By the explosion at the Lozar House, Ridgetown, Ont., one person was killed, while the second explosion, at Kippen, Ont., destroyed St. Andrew's church and injured five persons. It is feared that the pastor, Rev. Mr. McLennan, may lose his sight. The fine new brick edifice was rent and torn as if by an earthquake. The floor bulged up and the walls collapsed. The congregation was enjoying a social and the disaster came without warning. During the supper an odor of escaping gas was detected a moment before the explosion. The pastor and caretaker rushed to the cellar to shut off the gas supply and were just approaching the generator when the gas was ignited. It is not known definitely whether the explosion was due to the carelessness and negligence of those having charge of the machine or whether it was purely accidental.

The Queen's Hotel at Pilot Mound, Man., was on November 30th destroyed by fire, said to have been caused by the gas machine blowing up. A fourth explosion occurred in an hotel at Cornwall, Ont., but fortunately without serious results.

SPARKS.

Good advertising is the path finder for all who seek success in business.

"Wire for us and we will wire for you" is the latest bulletin board catch phrase used by a New York electrical fixture man.

A branch office of the Provincial Boiler Inspectors Department has been opened in Vancouver, B. C., with Mr. George O. Madigan in charge.

The by-law authorizing the purchase of the electric light plant by the town of Wingham, Ont., from Mr. Walter Green, for the sum of $28,000, was carried by a large majority on November 10th.

A dispatch from Chatham, N. B., under date of November 9th, said: "During a heavy snowstorm yesterday the snow pressed down the electric light wires on the telephone wires and the whole telephone system was put out."

Ironsides, Rennie & Campbell, contractors for the tunnel for the Vancouver Power Company between Lakes Beautiful and Coquitlam, B. C., have just purchased six powerful drills, known as the Rand Giant and having cylinder diameters of 3 5-8 inches. These drills are operated by an air compressing plant.

The city council of Stratford, Ont., has signed an agreement with the Stratford Railway Company. The company are given a fifty year franchise, exemption from taxation for twenty years, and the right to furnish light and power. Running rights are to be granted to other radial railways in the city, and the city service is to be completed and in operation by December 31st, 1904.

The new factory of the Shewin-Williams Paint Company, in Montreal, is to be operated by electric power, for which purpose two Westinghouse alternating current generators of 75 and 125 kilowatt capacity respectively will be installed in a separate power house 103 x 172 feet. There will be two Corliss engines of 130 and 200 horse power.

QUESTIONS AND ANSWERS

1. When paralleling two generators, one carrying a lighting load and the other induction motors, we understand that the combined load will have a different power factor from either of the others. Will you please tell us whether this power factor is higher or lower than the others, also will it be the same on both generators?

Ans.—The resultant power factor obtained from the combination or parelling of two circuits of different power factors will be intermediate between the two, that is, higher than the lower and lower than the higher one. How much it will differ from each, of course, depends on their respective values, and also on the relative amounts of energy in the two circuits. The power factors of the loads on the two generators depend upon the field excitations and the driving powers, they may be the same or they may be different, according to the adjustments made by the attendant.

---

2. Will you send explanations of the following terms either by letter or through your paper: (a) "Three-phase" as applied to machines, distingushing between three-phase and two-phase. (b) Also what is the difference between a three-phase and a six-phase machine? (c) Again, what does S. K. C. stand for as applied to machines and transformers? (d) How does a booster raise the voltage on a line? (e) Suggest a means of using a 110 volt D.C. generator (used for lighting purposes) to do electro-plating. (f) Will you please give a table showing the average weight per 1,000 feet of rubber covered and weather-proof wires? I have tables of the weight of cotton-covered wires but not for those above mentioned.

Ans.—(a) A single phase alternator is one which has but one winding, and thus generates but one voltage. This, starting from zero, rises in a certain direction to a maximum, then decreases to zero, then rises again, but in the opposite direction, and finally falls to the original zero point. The complete round or series of operations is called a cycle. Now, if two of these machines were mechanically coupled together so that the maximum voltage of one was generated just a quarter of a cycle after that of the other, the two potentials would be in what is called two phase relation. Similarly, if three machines were rigidly joined so that their three E. M. F.'s attained their maximums each one-third cycle behind the one preceeding it, their voltage would have what is called a three phase relation to each other. But it is unnecessary to have two or three separate machines, as the case may be, as the relative position of two or more E. M. F.'s can be maintained by placing the two or three windings in one frame, they being spaced so as to produce the phase relations desired. Such a machine is then a two phase or three phase generator, according to the method of winding employed, and is obviously cheaper and less complicated than separate units. Besides uniting the frames, it is found that it is also practicable to unite the various leads and so the six leads from three single phasers are joined to make three leads for a three phaser. It is also practicable to unite two of the four wires which would come from two single phasers, and thus they also are sometimes operated with three leads only. (b) Similarly to the above, a six phase machine is one giving six potentials, each one-sixth of a cycle behind the other. It is a system employed practically only with rotary converters, and even then the generating system is either two or three phase, being turned into six phase by means of static transformers. (c) The letters "S. K. C." are the distinguishing device or trade mark used by the Stanley Electrical Mfg. Company to distinguish its product from the various other goods on the market. They are the first letters in the names of three of that company's well known engineers, men who practically organized it, namely, Messrs. Stanley, Kelley and Chesney. (d) By being connected in series with one side of the circuit to be boosted, so that its potential is added to that of the main generator or transformer. (e) The method to be adopted depends very much on the articles to be plated. You can use a rheostat in series with the bath to keep the current within the required limits; if you have two or more baths taking the same amount of current they can be run in series, which will tend to reduce the rheostatic capacity required. Again, you might run the armature at a slow speed, and connect the fields in parallel if there is more than one field coil, or, if the articles to be plated are small you can run the machine at normal voltage and use a few incandescent lamps as a rheostat. (f) The following are average weights per 1,000 feet of the more common sizes of wires. For a complete list write any manufacturer.

Gauge.	Standard Weatherproof.	Slow Burning Weatherproof	Rubber Covered.
No. 4	145	180	180
6	95	130	130
8	65	85	90
10	40	60	55
12	28	40	40
14	18	33	30

---

4. Can an induction motor be used as a generator, or are they ever run that way?

Ans.—An induction motor can be used as a generator if excited by some other alternating current circuit, which may or may not be of the same frequency as that for which the motor is built. It cannot be excited from a direct current circuit, nor will it excite itself. This method of operation is not by any means a standard one, though it is sometimes used in case of necessity. If it is desired to provide emergency generator capacity, to be used normally as motors but installed so that they can be coupled up if necessary to some prime mover, the synchronous type is selected. Machines of this form with exciter and switchboard are perfectly self-contained and can be used with perfect satisfaction as either generators or motors, whereas the operation of the induction type, as advised above, requires some other alternating circuit for excitation, which is not always available in emergencies.

---

4. Is not an induction motor a constant speed machine, the same as a synchronous motor?

Ans.—Both synchronous and induction motors are often spoken of as being constant speed machines, compared with direct current apparatus, merely to indicate that they cannot attain any abnormal speed or run away, as is possible with shunt wound in direct current machines if the field gets weakened, or with the series wound type if the load gets too light. The synchronous motor makes absolutely the same number of revolutions, in any given period, as that made by the generator running it, providing they have the same number of poles. If not, the products of the number of poles and the number of revolutions of the two machines will be absolutely the same, and so, as long as the generator speed is kept constant, that of the synchronous motor will be absolutely constant also. On the other hand, the induction motor runs on the average from 1 to 4 per cent. slower than synchronism, depending on the size, design and load. That is, like the shunt wound direct current motor, it slows down slightly as the load gets greater, and speeds up if it be decreased.

5. What is the size of the engine required to drive a given size of dynamo?

ANS.—We do not exactly understand your question. If you want to know the cylinder sizes we would advise you that it is impossible to give them without first knowing the size of the dynamo. If you want the relation between the power of the two machines you will find that as a general rule an engine of 1½ times the horse power of the dynamo rating in kilowatts will be satisfactory, that is, a 60 k.w. generator will take a 90 h. p. engine to drive it. This is true only for direct connected units. For belted machines you will require an engine approximately 10 per cent. larger.

IMPORTANT STEP IN ELECTRIC TRACTION.

Mr. Frank H. Mason, U. S. Consul at Berlin, Germany, writes under date of August 27 as follows:

"A practical experiment of the highest importance and interest in the development of electrical railway service is now in progress on a suburban line between Niederschonweide and Spindlersfelde, in the southeastern quarter of Berlin. During the past week there has been in daily operation a car driven by a new motor, invented by a young Austrian electrician and built from his plans by the Union Electric Company, of Berlin. This motor achieves with apparently entire success what has not been accomplished hitherto—at least not in Europe—viz., it propels the full-sized service car at any desirable degree of speed without employing any cumbrous and expensive regulating devices, while deriving its energy from a single-phase alternating current of 6,000 volts, carried along the line on one small trolley wire and delivered directly to the motor without conversion to a lower voltage or a continuous current.

The far-reaching importance of this demonstration—which will be at once recognized by every electrical engineer—will be apparent when it is remembered that electric traction, which has proven so effective and economical for interurban and suburban service, has met hitherto some very serious economic difficulties when applied to long distances. The method heretofore employed has been to send over the line alternating currents of high pressure which are taken off at intervals by sub-stations equipped with step-down converters that reduce it to a continuous current of low voltage, which is fed into the trolley wire or third rail and thus transmitted to the motors of passing trains. As already noted, this works very well for short lines such as are required in city and suburban transit and which are thronged with constant traffic. But when the proposition is to extend the same practice to a standard railway, connecting two cities from 100 to 300 miles apart, the cost of the installation and working expenses become practically prohibitive. Besides the frequent substations equipped with transformers capable of converting the high-voltage alternating current into a low-pressure continuous one, there is the question of heavy copper conductors throughout the line, and this, added to the fact that the transformers and rotary converters must stand idle except when the converted current is taken off and used by some passing train, has hitherto rendered the proposition economically untenable.

When the high-speed experiments were tried last year on the Government railway line between Marienfelde and Zossen, an alternating three-phase current of 10,000 to 12,000 volts was carried along the line on three copper wires and conducted thence by trolleys to transformers carried under the floor of the car, whence it was transformed to 1,150 to 1,800 volts and passed into the three-phase induction motors. The car, as will be remembered, easily attained a speed of 140 to 150 kilometers an hour, at which pace the rails began to give way. The further experiments had to be postponed until a more solid and substantial track could be provided.

The present experiment has therefore a wholly different purpose. It involves no question of extreme high speed, but rather the transmission of a single-phase alternating current at a voltage (6,000 volts in this case) sufficient to carry it over a long line on a small and relatively inexpensive wire, and the direct use of the current, without transformation, by a motor capable of running economically at any desirable speed and which fulfills all the other requirements of electric traction. The point demonstrated by the tests now in progress is the effectiveness of the new motor for the special purposes to which it is applied. No sparking or other technical difficulty appears thus far to shadow the success of the experiments. The system eliminates the expensive substations, with their heavy initial outlay and operating expenses, and is so simple and direct in its working that it may, at least in theory, be applied to lines several hundred miles in length. If the distances are very great, of course the power may be transmitted from a distant waterfall or steam plant at any desired pressure—say, 20,000 or 50,000 volts—and then reduced in ordinary transformers, requiring no especial care, to the working-line voltage of, say, 6,000 or more. The present tests are over a line of 3 or 4 miles in extent, the length being immaterial. There may be encountered new technical difficulties when this distance is increased to as many hundred miles, but such difficulties are only such as may be met in any long-distance transmission and such as electrical science at its present stage is fully prepared to overcome. The new motor is believed to have bridged the chasm and opened the way to economical, and therefore practical, long-distance electric traction on railways of standard capacity.

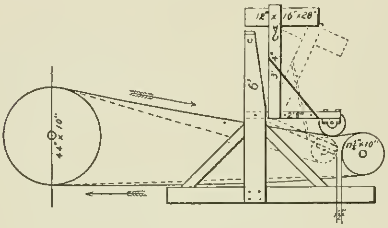
The Alpha Electric Company, manufacturers of electrical supplies, Montreal, is reported to have sold out to the R. E. T. Pringle Company, Limited.

Steps are being taken by the Dominion Rifle Association to introduce electrical power for the movement of targets at the Rockliffe ranges near Ottawa. Col. Tilton is working on a scheme by which it will be possible for the marker by simply pressing a button to raise and lower the target.

AUTOMATIC BELT TIGHTENER.

A correspondent of Power says: I am now using a tightener arranged in the manner shown by the sketch, which I believe is doing all that could be reasonably expected of a belt of this size. The belt is a 10-inch four-ply rubber belt, 49 feet 10 inches long, running off a 44-inch driver onto a 17¾-inch driving pulley. It drives a 54-inch rotary saw, 625 revolutions, cutting Alaska red spruce. Frequently the saw is buried the whole cut without the least sign of slipping of the belt. When the saw is out of the cut, the weight that the tightener applies to the belt is about 20 pounds. When the duty required brings the top and bottom sides within 4½ inches of each other under the tightener pulley, the weight applied to the belt by the tightener equals about 130 pounds.

Of course, the length of the tightener frame, the standard that carries the weighted box, and the weight placed in the box, governs the proportion of weight placed on the belt at different points. I find it is useless to overload with weight, and very often belts are too tight. I place my belt loose enough to give 4 to 5 inches sag in 10 to 12 feet to center, or, in other words, 5 inches sag to a belt when the centers of the two shafts are 24 feet apart.



Automatic Belt Tightener.

I have seen tighteners placed on or under a belt, then a lever used to pry up and block up until the belt would almost ring if hit. Such tension takes the spring and life out of a belt, and its only friend is the belt manufacturer; it never gives a belt a rest. Place your belt tightener right, run your belt loosely, and you will get lots of work and a long life. Give your belt a rest whenever you can; it needs it.

This form of tightener may be placed on horizontal, vertical, or belts at any angle, and if properly proportioned and properly loaded will surely give satisfaction every time. Construct your tightener frame so that if the belt doesn't run squarely on the pulley the frame can be moved slightly one way or the other, and the belt will run true.

There are right and wrong ways to run a tightener on a belt. For instance, take the tightener shown and turn it around, and the first time it goes down it will be very liable to break something—that is, if it is fastened properly. By placing the tightener about 4 inches from the driven pulley and having belt slack so there will be about 5 inches sag in the center of the belt in, say, 10 to 12 feet, when the strain comes on the belt the tightener drops, as shown by the dotted lines. This gives a greater percentage of belt grip on the pulley just at the time it is required, and when the load is thrown off the tightener is at once brought back and the strain released.

NEW SYSTEM FOR TRANSMITTING ELECTRICITY.

Mr. Oliver J. D. Hughes, U. S. Consul-General at Coburg, Germany, writes that a new system invented by two Alsatians for the transmission of electrical impulses without wires through the earth consists in both poles of an electric-current conductor being connected to the earth, whereby an electrical induction field is set up around each pole, the extent of which depends on the intensity of the current employed. In each of these two induction fields it is possible to utilize the electrical impulses produced at the place of generation by the introduction of two poles at suitable points within one of these fields. Relays, such as are well known in telegraphy and telephony, may be employed in order to transmit the electrical impulses over a wider area, these being connected to the two poles and their resulting currents being used to generate further fields. The inventors claim to transmit by means of their system telegraphic, telephonic, or any other desired electrical impulses, the transmission not being subject to outside influences, such as bad weather, storms, etc., factors which render the wireless transmission of electrical impulses through the air more or less unreliable.

ELECTRIC LIGHTING OF THE WELLAND CANAL.

The work of installing the arc lighting equipment for the Welland Canal is now under way. The new canal is 28 miles long and it is proposed to place a 2,000 c.p. a.c. enclosed arc lamp every 500 feet along the canal, with six lamps at each lock. The appropriation for this work by the Department of Railways and Canals for the current year is $100,000. The contract for the erection of the necessary poles has been given to Mr. Joseph Battle, of Thorold, and tenders will shortly be called for the electrical supplies, including arc lamps, transformers and transmission line material, and for the construction of the line and terminal station. The terminal station will be located at Thorold. It is proposed to install three-phase circuits for distributing the current to the motors for operating the lock gates, weirs, bridges and yard shops. The Lincoln Electric Light & Power Company, of St. Catharines, have been given a ten-year contract to furnish the electrical energy, which will be transmitted from the Decew Falls power station of the Cataract Power, Light & Traction Company. The plans for the complete equipment for lighting the canal were prepared by Roderick J. Parke, E. E., of Toronto.

A party of eastern capitalists have bonded all the Crown granted land from Cape Beale to Saritas Bay, on the south shore of Barklay Sound, British Columbia. The intention is to erect saw and pulp mills and to construct a tram railroad, to be operated by electricity, from Saritas to Duncans.

The Electro Manganese Company was incorporated some time ago under the laws of New Brunswick for the purpose of operating in Canada and treating the manganese as found by an electrical process. The company has established works at Shawinigan Falls, Que., and commenced operations a few days ago. The ore used is obtained from the Lower Provinces. Hitherto this material has been manufactured in blast furnaces from ore found in conjunction with rock, but an electrical process has now been perfected whereby bog ores, which are found in certain parts of Canada and which are high in manganese, can be successfully treated and a high grade of ferro manganese obtained. This material, which resembles bronze in appearance, is turned out in the form of pigs and is used by all manufacturers of steel rails. The company obtains its electrical power from the Shawinigan Water & Power Company.

MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, December 1st, 1903.

The Montreal Street Railway Company have been prohibited from running over street crossings in the suburb of Westmount at a greater speed than four miles per hour. Although ten mile speed is allowed between streets,the intersections are so frequent that the average speed obtainable is only five miles per hour. This is totally inadequate, as Westmount is from two and one-half to four miles from the centre of the city of Montreal. Westmount has only of late years been made a town, and its ambitions council are "feeling their oats" and stringing out by-laws, some of them to the great detriment of its inhabitants, the street railway speed control being one of such in question. Surely it would have been quite sufficient to have imposed "city speed" and cautioned against school streets to safeguard children coming to and from school at certain hours. Nevertheless, it ill becomes the management of the Montreal Street Railway to allow their motormen to open the front door and grin at the passengers the moment city limits are passed—ditto, the conductor. It should be remembered that the general public of the suburb are not in sympathy with the idiosyncrasies of the town council, and are entitled to respect in service rendered, be it slow or fast.

The Question Box at the last convention of the Canadian Electrical Association did not seem to elicit much information on the Nernst lamp. The circuits in Montreal are at 60 cycles, and motors of two or three-phase type are connected on quite a few. The single glower 110 volt Nernst has not been a signal success on such for some reason or other, possibly affected by motors? As we are all A. C. here someone's practical experience with them through the columns of the ELECTRICAL NEWS would be welcomed.

The Hewitt Mercury Vapor Lamp is beginning to be seen around New York stores. As it does not work on A. C. Toronto will have to tell us all about it. They are said to be on the market for 110 and 220 volt D. C.

The Eugene F. Phillips Electrical Works, of Montreal, have decided to construct a new factory in the town of St. Louis, the site for which, 100,000 square feet, was recently purchased. The municipal council has granted exemption from taxation for thirty years. The factory is to be completed by January 1, 1905, and the company undertakes to employ a hundred hands and to pay $35,000 a year in wages.

PERSONAL.

Mr. Duncan McDonald, assistant manager of the Montreal Street Railway, returned a fortnight ago from Paris, where he had been for some weeks on private business.

Mr. F. E. Hamilton, electrician, of Tottenham, Ont., has secured the position of superintendent of interior wiring, meters, and motors for the Berlin Electric Light Company, Berlin, Ont.

Mr. James Crosby has been appointed manager of the Halifax Electric Tramway Company, is succession to Mr. Frederick A. Huntress, who has accepted the position of manager of the Worcester Consolidated Railway.

Mr. Alex. Kennedy, a member of the well-known firm of William Kennedy & Sons, Limited, Owen Sound, Ont., dropped dead from heart failure on November 16th while superintending the erection of an elevator. He was 65 years of age.

Readers of the ELECTRICAL NEWS will regret to learn of the illness of Mr. T. C. Frenyear, sales manager for the Canadian Westinghouse Company, who was recently stricken down with typhoid fever while on a business trip to Fort William. As we go to press it is learned that his condition is much improved and he is believed to be on the road to recovery.

Mr. Charles H. Hines has been appointed electrical engineer for the Canadian Pacific Railway, with headquarters at Montreal. The office has just been created. Reporting to Mr. E. A. Williams, the superintendent of rolling stock, his duties will include a general supervision over all electrical matters, including power and lighting circuits, generators, motors, arc and incandescent lamps, and other electrical machinery and apparatus. The company has now under way a very large electrical installation at the new car shops in the east end of the city of Montreal, and electricity as a motive power is coming into more general use all over the company's lines.

Mr. Roderick J. Parke, electrical engineer, of Toronto, returned recently from Calgary, Alberta, where he spent about ten days making a survey of the water power of the Kananaskis Falls. It is proposed to develop and transmit the power to Calgary, a distance of fifty-four miles. While on the trip Mr. Parke took occasion to visit the Pacific Coast and reports conditions in the electrical industry there to be exceedingly prosperous. Contracting firms are busy and complain of a scarcity of good wiremen. He also spent a few days in Winnipeg and was much impressed with the rapid growth of that city.

Mr. J. Black, of Toronto, who is retiring after 40 years' service as boiler inspector for the Grand Trunk Railway, was the guest of honor at a banquet given by the company in Webb's Parlors last month. On behalf of the railway, Mr. W. D. Robb, superintendent of motive power, announced that Mr. Black would be granted a life annuity, and the firemen showed their appreciation of Mr. Black's services by presenting him with a handsome gold watch, chain and locket. Representatives were present from the entire system from Chicago to Portland, numbering in all 110. Mr. W. Kennedy,master mechanic, of Toronto, presided.

Mr. H. F. J. Porter, who has been associated with Westinghouse interests since the first of the year and has held the position of assistant manager of the Publishing Department, with offices in East Pittsburg and 10 Bridge street, New York, has been made second vice-president of the Nernst Lamp Company, of which enterprise Mr. George Westinghouse is president, with the duties of general manager and headquarters at Pittsburg. He assumed charge on December 1st. This appointment does not affect Mr. Porter's relations with the Publishing Department at the present time.

The Ontario Municipal Power Commission has appointed Mr. R. A. Ross, of the firm of Ross & Holgate, Montreal, as electrical expert and fifth member of the Commission. The other four members, who were named by the convention of the municipalities of Western Ontario, are Messrs. E. W. B Snider, of St. Jacob's; Adam Beck, M.P.P., of London; W. F. Cockshutt, of Brantford, and P. W. Ellis, of Toronto. Mr. Ross is no doubt well qualified to perform the services which will be required of him, as he has been associated with several important electrical transmission enterprises. It is understood that his duties will be those of a consulting engineer to all the hydraulic and electrical engineers who will be employed by the Commission to report upon the problem of obtaing power from Niagara.

SPARKS.

W. J. O'Leary & Company, of Montreal, are installing an electric light plant at Richibucto, N.B.

Messrs. Williams & Wilson, Montreal, Que., ordered from J.C. Wilson & Co., Glenora, Ont., a 38 inch vertical Little Giant turbine for the Ogilvie Milling Co.'s mill in that city.

The Winnipeg city council has decided to submit a by-law to the ratepayers to raise $1,000,000 to develop the Assiniboine water power and to establish a municipal gas plant.

The Sunbeam Incandescent Lamp Co., of St. Catharines, Ont. announce in their advertisement in this number that they are prepared to supply incandescent lamps of the highest grade,and of equal efficiency for high or low voltages.

Westinghouse gas engines are to be adopted in a new central station now under erection at Berlin, Ontatio. The initial installation will aggregate 460 horse-power, comprising three 13 x 14, three-cylinder, 125 horse-power, and one 11" x 12", three-cylinder, 85 horse-power vertical engine. These engines will operate on city illuminating gas of 650 B.T.U. calorific value, and drive direct-current generators for furnishing municipal lighting.

The Laurie Engine Company, of Montreal, have just supplied the St. John Street Railway Company with a horizontal cross-compound condensing Corliss engine, with cylinders 23 and 44 inches respectively. It is registered 900 horse power and will be directly connected to a 650 k. w. generator for street railway purposes. The fly wheel has a 16 inch face and a diameter of 18 feet and weighs 35 tons. Two other engines of 500 h. p. and 450 h. p. respectively are being furnished to the same company by the Robb Engineering Company, of Amherst, N. S., to be used for lighting purposes. These three engines will furnish more power than is at present developed, and the capacity of the plant will be nearly doubled when the new machinery is installed.

RAILWAY COMPOSITE TELEPHONE AND TELEGRAPH SYSTEM.

The Bell Telephone Company of Canada has recently equipped one of the C. P. R. telegraph lines between Montreal and Ottawa with railway composite telephone and telegraph apparatus, which allows telephone service to be added to grounded telegraph lines without interfering in any way with the telegraph service already carried on over such line. As the name implies, the system has been designed specially to meet the demands of railway companies for a service of this character applicable to terminal or way stations of lines of the above character. The length of the telegraph line and the number of way stations with which this system can be successfully employed depend largely on the character of the telegraph lines. The size and the material of the line wire and the amount of wire in cable are the most important factors limiting the range of the system. In general, it may be stated that it is usually possible to operate successfully over an ordinary telegraph line one hundred miles in length having five intermediate stations.

GENERAL DESCRIPTION OF THE SYSTEM.

The general arrangement of the system is shown on the accompanying drawing. At each terminal of that portion of the line over which telephone messages are to be transmitted is placed a terminal differentiator, consisting of an impedence coil in series with the line wire and a condenser from the line wire to earth.

As the telegraph battery is placed outside this piece of apparatus the latter serves to graduate the rise and fall of the telegraph currents so that Morse signals will not interfere with the telephone service and so that inductive or other disturbances will not be transmitted to the telephones from portions of the line beyond the coils.

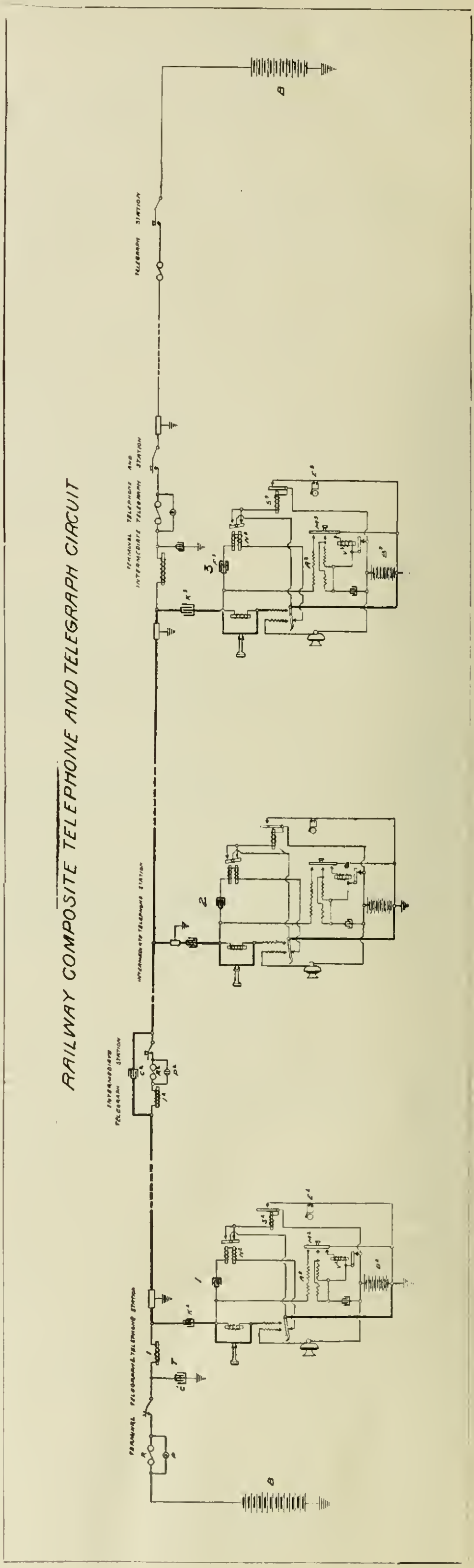
Each telegraph way-station is provided with an intermediate differentiator, consisting of a condenser and impedance coil. The impedance coil is placed in series with the telegraph relay, and relay coil and key are shunted by the condenser.

This apparatus affords a by-pass through the condenser for the telephone talking and signalling currents. Were it not for this apparatus the talking currents would be seriously reduced by the impedance of the relays and the telephone signalling currents would cause the relays to "chatter" or give false signals.

In addition to the above precautions the relays are directly bridged by polarization cells. The latter offer such opposition to the passage of the direct telegraph currents that their presence does not in the least interfere with telegraphic signalling. At the same time, they serve as a shunt for any telephone signalling current that, passing through the impedance coil of the intermediate differentiator, would otherwise affect the relay.

Each telephone set is connected to the line through a condenser, thus avoiding interference with the telegraphic service.

The set, in addition to the transmitter, receiver and induction coil, contains for calling a special vibrator operated by a push-button; and for receiving calls, a direct current bell controlled by a slow-acting relay, which, in turn, is controlled by a biased, polarized relay. For signalling and talking, a battery of 5 or 7


RAILWAY COMPOSITE TELEPHONE AND TELEGRAPH CIRCUIT
TELEGRAPH STATION
TERMINAL TELEPHONE AND INTERMEDIATE TELEGRAPH STATION
INTERMEDIATE TELEPHONE STATION
INTERMEDIATE TELEGRAPH STATION
TERMINAL TELEGRAPH & TELEPHONE STATION
3
2
1
T

Edison-Lalonde cells as found necessary is provided at each station.

SUB-STATION SET.

The station set is arranged to be mounted on the wall and is similar in general appearance to the standard magneto sub-station set. A special transmitter marked C. R. C. (Composite Railway Circuit) is employed with these sets. The receiver is of the standard type but is permanently shunted by a special impedance coil which is designed to divert from the receiver the traces of the telegraphic or other currents which otherwise would cause disturbing noises to be heard.

This impedance coil has a movable iron core which can be inserted into the coil, or removed from it, to a greater or less degree, thus widely varying the impedance and regulating the proportion of the current that is shunted around the receiver. The value of this impedance should be as high as is consistent with the necessary freedom from disturbing noise.

OPERATION OF RAILWAY COMPOSITE CIRCUITS.

The circuits used in the railway composite system are shown in the accompanying drawing. This drawing shows at the left a terminal telephone and telegraph station, next toward the right an intermediate telegraph station, next a telephone station which may or may not be associated with the preceding telegraph station, next a terminal and telegraph station, and beyond an isolated telegraph station. All telephone stations are connected between the line and earth.

At the extreme left hand terminal of the line is shown one of the telegraph batteries B, the telegraph relay R of the combined telegraph and telephone terminal station, the polarization cell P shunting and relay R, and the terminal differentiator T, consisting of impedance coil I and condenser C I. The telephone set at this combined station is connected to the line through condenser K2.

At this station B2 represents the local battery of 5 or 7 Edison-Lalonde cells. The transmitter, hook-switch, induction coil, receiver, and its shunting impedance are represented conventionally.

At V2 is a vibrator, operating through a coil, with a condenser placed around the vibrator contact, and the operation of the vibrator controlled by a key M2. This portion of the equipment provides the high frequency signalling current.

At N2 is a biased polarized relay, and at S2 a slow-acting relay, controlled by the former, and having connected to its own back-contact the direct current bell E2. This portion of the apparatus is for receiving incoming signals.

At the next station (an intermediate telegraph station) is shown an intermediate differentiator consisting of impedence coil I2 and condenser C2. The relay R2 is also shunted by the polarization cell P2.

The remaining stations so closely resemble those referred to above as to require no further description.

METHOD OF SIGNALLING.

To call a distant station, as for example, station 3 from station 1, the operator at station 1 depresses key M2, which causes the circuit of battery B2 to be closed through the vibrator V2, the operation of which produces an interrupted current in the split primary winding of coil A2 and consequently a similar induced current being transmitted through the condenser K2, along the line, through the condenser C2, of the intermediate differentiator to station 3, and beyond.

At station 3 this signalling current flows through condenser K3 and F3, and the polarized relay N3 to earth. This current causes the armature of relay N3 to vibrate, thus opening the circuit which previously existed from the battery B3 through the slow-acting S3 to earth. The armature of relay S3 falling back, closes the circuit of the direct current bell E3 which gives the signal.

The talking circuit is of the simplest character and requires no explanation.

DEPRECIATION OF TELEPHONE EQUIPMENT.

By Henley V. Bastien.

The following excellent paper on the above subject was recently read before the Kentucky Telephone Association at Paris, Ky. Mr. Bastien is a graduate from the electrical engineering and telephone departments of Perdue University:

DEPRECIATION.

Depreciation, and what is it? Depreciation is the lessening in value of a particular thing due to some change in its condition, or a change in its relation to other things. As applied ordinarily to telephony it refers to the lessening in value of a plant due to the decay of poles, wires, switchboards, etc. Some would have you to believe that there is a depreciation in the plant due to the rapid advancement in the science of telephony. While this was undoubtedly true a few years ago, now I believe that the time has come in which apparatus is so well perfected that no one need fear necessity of having to throw it into the scrap-heap before it has served out its natural life.

The object of this paper is to investigate the lasting qualities of the various materials and apparatus used in the construction of a modern telephone plant, and to determine the annual rate of depreciation of the parts and the whole due to the ravages of wear, tear and time; and to mention the importance of giving it due consideration in the financing of a plant.

The argument is advanced by some that by proper maintenance of a plant it can be kept in as good condition as when built. This, I think, is entirely unwarranted; a telephone plant, like all other human productions, will wear out. It is practically conceded by the best telephone engineers that the only business way to provide for this wearing away is to lay by each year a certain per cent. of the original cost of the plant to be used for rebuilding when found necessary. This depreciation fund may be placed in a bank, loaned out at interest or reinvested in the telephone business, if thereby it will pay more than the current rate of interest. If this latter method be followed, it will be necessary to borrow money for rebuilding the original plant. But this will be alright, for, during the time of operation, the plant should more than double in size—increased by compound interest so to speak—with only the original part of the plant to be rebuilt. So long as it is strictly borne in mind that there is a depreciation, and provision made to meet it, all will be well. But if that which should be reserved for depreciation be paid out in dividends while the plant is new, an unwarranted premium will be placed on the stock at this time, and an injustice and hardship on the stockholder when the time comes for rebuilding.

Happily though for the Independant movement, the greater number of the companies do, in one way or another, provide for depreciation, and they do it most abundantly. The percentage usually considered to be right varies between 8 and 12 per cent. A most pleasing extreme from the company that lays by nothing.

Aside from the necessity of providing for rebuilding, there is another reason why depreciation should be studied—it enables the engineer to build or maintain the plant from the most economical materials (service, original cost, maintenance and length of life being considered). He must not use cheap materials, labor or apparatus because they are cheap; neither is he justified in buying that which costs most with the expectation of it lasting longest, and giving the best service. But to do justice to the company, himself, and his profession, he should investigate, keep records and thoroughly familiarize himself with these things.

I would like to say here that the figures which I use have been decided upon after a great deal of correspondence and investigation, and are not agreeable by any means, representing the opinions, as near as I can ascertain, of men who are best informed on the subject.

A plant is divided into two general heads

I. Office and subscribers' equipment.
II. Outside construction.

1. The first division is divided into three classes:
  a. Local battery.
  b. Central battery.
  c. Automatic.

Of these I shall discuss only the local battery and central battery. The automatic has not been in operation long enough for us to say anything regarding its lasting qualities.

(a) Local battery systems were entirely used by both Bell and Independent companies up to about 1897, local battery boards frequently giving continual service in the Bell exchanges for 10 to 12 years; phones being used even longer than this. When it is remembered that these old boards and phones were very inferior in design and construction, and were not kept repaired in the best manner, are we not justified in saying that modern local battery switchboards and phones, built by reliable firms, should last 20 years, if maintenance be properly looked after. This gives 5 per cent. depreciation.

(b.) In central battery systems there is a finer, neater mechanical arrangement that is accompanied by much less wear and tear than in the local battery, and consequently a longer life may be expected. It is thought that 25 years of service may be had of a first-class central battery equipment. Thus per cent. depreciation.

II. Outside construction is divided into two classes:
  a. Underground.
  b. Aerial.

In underground construction and especially conduits we have the most permanent part of the plant. Conduits built of vitrified clay or terra cotta and concrete, being removed from sun and rain, freezes and thaws, are almost as everlasting as the Pyramids themselves. A rate of two per cent. is charged off to underground conduits, though I see no reason why 1 per cent. would not suffice.

Underground cables: The great enemy of underground cables in the past has been electrolysis. But high insulation conduits and greater care in installation have about eliminated these difficulties. In the past, cables were frequently destroyed, wholely or in part, by high potential currents and lightning discharges. However, by the use of improved protectors these have ceased to be factors. We have practically nothing to go by in determining the life of a well protected cable except guess-work. In view of the fact that an old cable is worth considerable as junk when discarded, a rate of 2 per cent. has been decided upon.

(b.) Aerial construction: Poles. Cedar and chestnut poles are almost entirely used in this country. Cedar poles 24 to 30 inches circumferential butt measure last about 15 years. Poles 30 inches and upward last about 20 years. Corresponding size chestnut poles will last 10 and 15 years respectively. As the tendency is toward using poles of the larger size, these only will be considered. Thus 5 per cent. for cedar and 6⅔ per cent. for chestnut.

Creosoted poles. Creosoted pine poles erected 30 years ago in England are still in good condition and will apparently las some time yet. I am informed by a gentleman who began creoscting paving blocks 32 years ago, that the first blocks treated are still sound and good, apparently good for 32 years longer. He is of the opinion that creosoted timber can be depended upon for at least 35 years. A depreciation on poles and cross arms of 3 per cent.

Cross arms of first-class long leaf pine will last only about 12 years, 8⅓ per cent. depreciation. If arms painted every two or three years, they can be made to last as long as the best cedar poles. 5 per cent. depreciation.

To obtain the above figures, it is necessary that arms and poles be not unduly strained, a factor of safety of 10 being about right.

Pole hardware: Bolts, braces, screws, steps, strand, etc., will last as long as the poles on which they are placed, if well galvanized. According to the modern practice it is undesirable to use plain hardware of any kind.

Aerial cable: If aerial cable is well put up, not run through trees, and well protected from lightning and high potential currents, it will last about 20 or 25 years, 4 per cent. being ample for depreciation.

Copper wire: There is practically no depreciation in copper wire due to the elements. Cutting and splicing will eventually render it useless. Copper wire, as junk, will about half replace itself. 2 per cent. is charged for depreciation.

Iron wire: The life of iron wire varies considerably in different localities, 3 to 5 years being a fair average in smoky districts; while through the open country it will last as long as 13 to 15 years. Under favorable conditions, 7 per cent. is about right.

General summary:

I. A modern exchange with central battery equipment and a large percentage of underground construction, creosoted poles and cross arms, copper wire leads and first class maintenance should show no more than 2½ to 3 per cent. depreciation.

II. Toll lines of creosoted poles and arms, copper wire leads, and well guyed, will have a depreciation of about 3 per cent.

III. Medium and small exchanges, with untreated poles and arms and galvanized iron wire, cable where necessary—from 5 to 7 per cent.

IV. First class country lines, untreated poles and arms, galvanized wire, from 7 to 8 per cent.

In conclusion, let me say this: Build your plants well. Build them in that "logical way," like the deacon built "that wonderful one horse shay" and your maintenance bills will be small. Impress on your maintenance department that "a stitch n time saves nine." Then your depreciation will be a minimum.

SHORT CIRCUITS.

Samuel Gidney, of Mink Cove, N. S., has purchased the entire stock of the Westport & Digby Telephone Company.

It is reported that the Merchants Telephone Company, of Montreal, purpose seeking a franchise for the operation of a system in Ottawa.

Incorporation has been granted to the Stark Telephone, Light and Power System, manufacturers of electrical apparatus, Toronto, with a capital of $1,000,000.

A joint stock company has been formed at Grand Prairie, B.C., to equip and operate a telephone service connecting Kamloops, Grand Prairie, Armstrong and Vernon.

The New Brunswick Telephone Company and the Union Telephone Company have both completed the extension of their respective lines from St. John to Grand Falls, N. B.

The organization of the Canadian Telephone Company was completed last month and a deposit of $25,000 made with the Dominion Government. The company will have its headquarters in Ottawa, where it has applied for a civic franchise. The directors elected are as follows: Charles Robinson, Scranton, Pa., president; Robert Bickerdike, M.P., Montreal, 1st vice-president; F. G. Stegmaier, Wilkesbarre; W. McCreary, M. P., Winnipeg; Geo. Fowler, M. P., Sussex, N. B.; Frank J. Leonard, New York, manager; J. R. Means, Scranton, treasurer, and J. T. C. Thompson, Ottawa, secretary. The total capital of the new company is $1,000,000.

The annual meeting of the British Columbia Telephones, Limited, was held at Huddersfield, England, October 21st. The report stated that the expenditure for improvements and extensions during the year ended June 30, 1903, amounted to £7,334, and the purchase of the plant of the Columbia Telephone-Telegraph Company involved a further expenditure of £7,668. A new switchboard and new instruments for the Victoria exchange, now being installed, would cost $15,000, while the estimated cost of laying a cable between the mainland and Vancouver Island was £35,000. In view of these expenditures the directors decided to carry forward the whole of the balance standing to the credit of the profit and loss account.

A dispatch from St. Paul, Minn., states that Mr. O. C. Greene, superintendent of the Northern Pacific Telegraph System, and Mr. Dildine, assistant superintendent, recently performed the novel feat of telegraphing 560 miles without the aid of batteries. The electricity was taken from the atmosphere during the great electric disturbance which lasted twenty hours. Messrs. Greene and Dildine conducted some interesting experiments and accurately measured the atmospheric intensity. The greatest pressure measured at any one time was 800 volts. This was the maximum register of the voltmeter used. The greatest range shown was 370 degrees swinging from the negative to the positive polarity. Both millimeters and voltmeters were used in the experiments.

POSSIBILITIES OF THE INCANDESCENT LAMP.

By H. D. Burnett,
Superintendent Lamp Department Canadian General Electric Co.

Very few people appreciate the full possibilities of the incandescent electric lamp. There is no difficulty in getting from it, if one knows how, any quantity of light desired; any division or distribution; any degree of brilliancy or whiteness of light; any degree of dullness or redness to suit such as find "the incandescent light too bright for their eyes;" any length of life desired, although very long life is not economical at average cost of current, and accompanied, as it usually is, by great reduction in candle power, it is not desirable.

With the cost of electric light, at present average prices for current, about as cheap as gas or oil, and so unquestionably superior to gas and oil in healthfulness, convenience and cleanliness, what remains to be desired? Surely, if everyone could have the advice of a disinterested expert so that his particular requirements might be fully satisfied, no one would be without the incandescent lamp in this day when a lighting station is to be found in every town. It is for the purpose of calling attention to a few important points not generally understood that this is written.

While thousands of lamp users will testify to the great convenience and perfection of the incandescent lamp—compared with other illuminants—still there are those who, through ignorance of its possibilities, have objections to the particular kind of light that may be supplied to them. It is to the interest of the station manager to study every complaint. A satisfied customer is his best advertisement. The complaint most frequently made is the general one of unsatisfactory life. The cause of this in 75 per cent. of all cases is found to be that the voltage has been too high for the lamps, it may be for only a few minutes each day.

Hold a white paper behind the lamps, and if the glass is noticeably darkened after a total run of less than 50 hours you have a sure sign that the voltage has been too high for the lamps. It is probably at times, if not regularly, from 5 to 10 volts higher than that marked on the lamps. The darker the bulbs the more certain you can be that the lamps have been strained, provided they have been in use but a few weeks. 16 and 32 c.p. lamps of 3.5 watts per candle efficiency will stand an occasional increase of 2 or 3 volts above normal without serious harm, but 8 or 10 volts increase will very rapidly shorten the life of the lamps and, at the same time, greatly reduce the candle power due to the darkening of the bulb and deterioration of the filament.

It is of first importance then that the lamps be selected of a voltage suited to your circuit if you wish to have satisfied customers.

Note that it is not necessary to change the voltage in your station. Your regulation may be satisfactory, and yet you may be getting unsatisfactory light or dissatisfied customers simply because you do not supply lamps of a voltage best adapted to your circuits.

Because your plant was designed for 104 volts it does not follow that 104 volt lamps are best adapted to your present conditions and throughout your entire circuits.

Every lamp manufacturer makes a complete line of voltages to suit all conditions. Our standard voltages are 50, 52, 54, 96, 98, 100, 102, 104, 106, 107, 108, 110, 112, 114, 117, 120, 125. The lamps of any one voltage are exactly as good in every respect as lamps of any other voltage, while lamps of 104 and 110 volts, being more largely called for, cannot usually be so promptly supplied as lamps of other voltages. Some of the largest central stations are to-day using regularly such voltages as 106, 107, 108, and 114 volts, while a large number of smaller consumers are finding other voltages better suited to their circuits than 104 and 110.

Let us suppose that a customer is now using 104 volt, 16 c.p. lamps of 3.5 watts per candle, i.e., each lamp consuming about 56 watts.

If the life is unsatisfactory examine the voltage at his lamps, and if you find it to average about 106 volts, and never higher than 108 or 109, supply him with 106 v. lamps of same c.p. and efficiency. A 104 v., 16 c.p., 3.5 watt lamp when run at 106 volts will have a useful life of only three-quarters that of the 106 v. lamp of same c.p. and efficiency.

"If the light is poor" see if the voltage is not often 3 or 4 volts below that marked on the lamp. If 102 volts is nearer the average, supply 102 volt lamps or whatever other voltage is necessary to make the lamps give their full candle power. Running a 104 volt lamp at 102 volts reduces the candle power 12 per cent.

If the voltage is correct (104) and the customer wants more light than 16 candles, you can easily satisfy him without paying the extra price of higher c.p. lamps by giving him either 102 volt or 100 volt, 16 c.p. lamps.

A 102 volt, 16 c.p., 4 watt lamp, when run at 104 volts, will give 18 c.p. at an efficiency of about 3.8 watts per candle, and 45 per cent. longer life than the 104 v., 16 c.p., 3.5 watt lamp that he has been using.

A 100 v., 16 c.p., 4 watt lamp, when run at 104 volts, will give 20 c.p. (efficiency 3.6 watts per c.p.) and longer life than the 104 v., 16 c.p., 3.5 watt lamp. The same applies to a 106 v., 16 c.p., 4 watt lamp when run at 110 volts.

A 102 v., 16 c.p., 3.5 watt lamp, when run at 104 volts, will give 18 c.p., but the efficiency being about 3.3 watts per candle, the life will be about 25 per cent. shorter than the 104 v. 3.5 watt lamp on the same circuit.

When a lamp is run 2 per cent. above its normal voltage (for example, a 102 v. lamp run at 104 v.) it will take about 2 per cent. more current (amperes) than at normal voltage, and the watt consumption will increase about 4 per cent. The meter customer should be willing to pay for 4 per cent. more watts for he is getting 12 per cent. more light from the lamp. This applies to any lamp whatever the efficiency or candle power.

If the customer finds the 104 v., 16 c.p., 3.5 watt lamp "too bright or hard on the eyes," first try the frosted lamps, which disperse and subdue the direct light rays from the filament, and if that does not satisfy him give him 108, 110, or 112 volt lamps, frosted if desired.

A 112 v., 16 c.p., 3.5 watt lamp, when run at 104 volts will give about 10 c.p. at an efficiency of about 4.6 watts per candle, while the light will be much less bright or intense, and more red in color than the 104 v. lamp because of the change in efficiency. The above illustrations show the wonderful adaptability of the incandescent lamp to varied conditions and requirements.

Wide acquaintance with the actual conditions present in lighting plants leads to the conviction that over 90 per cent. of all installations in Canada to-day would find it to their very great advantage to use lamps of some other voltages than 104 or 110.

Note that by selecting lamps of the proper voltage very many stations now using 4 watt lamps (of too low voltage) could get just as long life and a more satisfactory light from 3.5 watt lamps, and thus add over 14 per cent. to the capacity of their plant without any additional expenditure for apparatus or wire.

The best efficiency for the average central station in Canada, with fairly good regulation, is 3.5 watts per per candle for sixteen and higher c. p. lamps. 4 watt lamps, formerly used extensively, are rapidly being superseded by the more efficient lamp, while some large central stations that were using a still higher efficiency (3.1 watts per candle) have recently adopted 3.5 watts per c. p. as being more satisfactory, all things considered.

It does not seem to be generally known that lamps of lower c.p. than 16 necessarily have filaments that are thinner and more fragile than the 16 c.p. filament. If, then, they are made of the same efficiency they must be shorter lived than the 16 c.p. lamps.

We therefore advise that where 16 and 32 c.p., 3.5 watt lamps are used that 8 and 10 c.p. lamps be about 4 watts per c.p., 5 c.p. lamps be about 4.5 watts per c. p., and 4 c.p. lamps be about 5 watts per c.p. These efficiencies, being our standard, are always kept in stock, and can be supplied more promptly than any other efficiencies.

A reliable portable voltmeter is an indispensable adjunct to every lighting station. This should be provided with an attachment plug for taking the voltage from the lamp socket. Such instruments should be checked occasionally with others, newly purchased or recently calibrated.

PUBLICATIONS.

The Woodward Governor Company, Rockford, Ill., have issued a new catalogue describing and illustrating their governors for water wheels. It contains much of interest to the hydraulic engineer.

We have been favored with a copy of a paper on "The Influence of Electricity on the Development of Water Powers," read before the New England Cotton Manufacturers' Association by Mr. F. A. C. Perrine, D.Sc., of Pittsfield, Mass.

The Standard Tool Company, Cleveland, Ohio, are among the largest manufacturers of twist drills and similar tools in the United States. Their catalogue, recently issued, is very complete and should be in the hands of all persons interested.

The Canadian General Electric Company, Toronto, have just issued Bulletin No. 830 referring to the Thomson high torque induction wattmeter. The efforts of this company have been directed towards the production of a meter which would not only be initially accurate under all reasonable variations of conditions, but which might be expected to remain accurate and retain its operative value through a long period of use.

"Notes on Electric Railway Economics and Preliminary Engineering," by W. C. Gotshall: This book is published by the McGraw Publishing Company, of New York, and is based upon a series of lectures which the author delivered at Lehigh University, the subject of which dealt with the economics of the preliminary and other determinations and the construction and operation of high speed and heavy traction interurban electric railroads. It is a valuable addition to electric railway literature.

NEW TELEPHONE LINE

A new copper metallic line has just been completed from Simcoe to Port Rowan. The towns listed below can now be reached from Toronto at the following rates :

Port Rowan - 50c.
St. Williams - - 50c.
Vittoria - - 40c.

THE BELL TELEPHONE CO. OF CANADA

ANY NEW CUSTOMER

Who sends us an ORDER this month through this advertisement will be allowed an extra 10 per cent. Does it pay to advertise ?

THE HILL ELECTRIC SWITCH CO., LIMITED
426 ST. PAUL STREET, MONTREAL

BINDING SECT. AUG 20 1968

TK Electrical news and
1 engineering
E44
v.13

~~Physical &~~
~~Applied Sci.~~
~~Serials~~

Engineering

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

ENGIN STORAGE